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BRITISH JOURNAL OF SOCIAL MEDICINE

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THE RELATION OF MORBIDITY TO AGE IN AN ARMY POPULATION

BY

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(*Received April 1, 1946*)

1. Introduction

Public health statistics provide a wealth of material with reference to the relation of age to mortality risk from individual diseases; and it has long been customary to adjust mortality rates by means of appropriate standardizing factors to forestall erroneous comparisons of crude deaths in populations of different age structure. Within the framework of private practice, civilian medicine provides no comparable opportunities for an exact study of the relation of age to risk of contracting diseases, other than such as are certifiable to public health authorities or such as are speedily fatal. Indeed current medical treatises and articles abound with figures for proportions of cases examined in different age groups cited as an indication of the liability of individuals to contract a particular disease in a given age group. It should be—but is not in fact—needless to remark that this procedure is highly misleading. Naturally, the physician meets very few cases of peptic ulcer among males between the ages of 95 and 99 inclusive, for the simple reason that there are in fact very few males alive at that age. The practice of putting on record such *case-age* distributions, in contradistinction to *age-incidence* distributions exhibiting frequency of onset related to the appropriate population at risk at a given time of life, is a counsel of despair consequent upon the difficulty of delimiting the population from which a civil hospital draws its patients, and hence of defining the relevant demographic data for drawing correct conclusions.

Correct information of this sort is of value both because it may furnish clues for an attack on the nature of the ageing process, and because it is a prerequisite of medical man-power planning in a society with a swiftly-changing age-composition. The Army, with an all-in system of social medicine and a complete population census, therefore offers a unique opportunity for studying the relation of age to

morbidity risks. To be sure, it has the disadvantage that it can provide no information with respect to the oldest and youngest age groups; and it is a selected population. However, any community subject to large-scale emigration and immigration is a selected population in the same sense, if not to the same extent; and in total war the selectivity of the recruitment machinery is minimal. It is a fact to which we should give due weight; but it is by no means such as to make the resources of Army statistics valueless to medical science in this context. With this end in view they supply two classes of documentary material respectively relating to

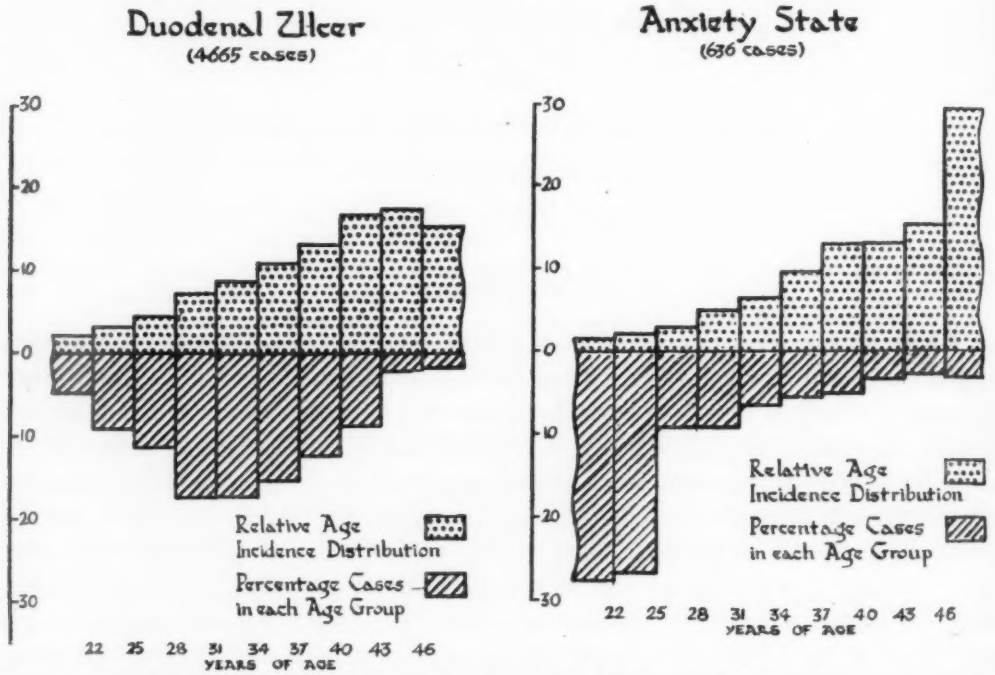

FIG. 1.—Comparison of percentage case distributions (below base line) with relative age-incidence distributions (above base line) of medical discharges for *duodenal ulcer* (4,665 *male* cases) shown on the left, and *anxiety state* (636 *female* cases) shown on the right.

discharge from the service on medical grounds (Army Form B.3978), and to hospitalization (the hospital record card Army Form I.1220). These documents share a merit which does not pertain to civilian certifications of infections or deaths, inasmuch as the diagnosis recorded thereon, in contradistinction to diagnosis on documents relating to "forward" medical units, is that of a specialist. Such are the sources of what follows.

In view of prevalent confusion between case-age distributions (proportions of cases examined in different age groups) and age-incidence distributions, which truly record risk of onset at different ages, it is pertinent to cite at the outset two examples (Fig. 1) which emphasize how grossly lack of due consideration of

differences with reference to population at risk in different age groups may distort judgments based on clinical impressions gained from examination of patients.

2. Age Distributions based on Sampling

An age-incidence distribution, as here defined, is a specification of age-specific rates for successive age groups. In what follows I_x stands for the specific rate of the xth age group, i.e. the ratio of all cases of a condition in that age group during a given period to the contemporary population at risk in the same age group. S(. . .) stands for summation of items of the class specified within the brackets. For graphical representation of age incidence distributions of different diseases, it is advantageous to reduce all histograms to the same area. If $T_i=S(I_x)$ stands for the total of successive values of I_x over the entire age range, we accordingly define a ratio R_x which satisfies this requirement, i.e.

$$R_x=100\ I_x\div T_i;\ \textit{and}\ S(R_x)=100$$

The representation of an age distribution in this way has a further advantage. Owing to loss of documents through enemy action or circumstances related to the exigencies of war, the total records of cases from a given theatre in a given period available for this enquiry are inevitably defective, though *not* in such a way as to bias the proportion of individuals assigned to a given age-group. If we do not know the exact number of cases of a disease in a population, we cannot compute the absolute age-specific rate I_x; but we can estimate the relative age-specific rate R_x if we know the age structure of the population, and the proportions of cases in each age group of an unbiassed sample of cases. This is evident from the following considerations. Let p_x be the proportion of the population in the age group x, P_x the actual number of individuals therein; C_x the corresponding *number* of cases of a disease, c_x the corresponding proportion which we can *estimate* by sampling, T_p the total size of the population in all age groups, and T_c the total number of cases. Thus $p_x=P_x\div T_p$ and $c_x=C_x\div T_c$. By definition we then have:

$$I_x=C_x\div P_x=c_x.T_c\div p_x.T_p=(c_x\div p_x)\ .\ (T_c\div T_p)$$

If we denote the ratio $(c_x\div p_x)$ by q_x and by T_q the summation of this ratio over the complete age range,

$$R_x=100\ I_x\div S(I_x)=100\ q_x\div T_q$$

Since we can estimate q_x by sampling, we can also estimate R_x without recourse to a *complete* census of cases such as we require for the determination of I_x. Needless to say, the ratio R_x like q_x and I_x is not *additive*, i.e. $R_{x+y}\neq R_x+R_y$. Distributions of this sort are therefore comparable only if based on the same classification with respect to age.

The distribution defined by R_x suffices for the calculation of age-standardization factors in conformity with the usual procedure. If I_s and I_c respectively stand for the standardized and crude incidence of a disease, we define the standardizing factor F as such that $I_s=F.\ I_c$ or $F=I_s\div I_c$. If ${}_sp_x$ and ${}_cp_x$ are corresponding

proportions of individuals of age group x in the standard and actual populations at risk,

$$I_s = S.\ ({}_sp_x.I_x)\ ;\ I_c = S({}_cp_x.I_x)$$
$$F = S.\ ({}_sp_x.I_x) \div S({}_cp_x.I_x)$$
$$= S.\ ({}_sp_x.100.I_x \div T_i) \div S({}_cp_x.100.I_x \div T_i)$$
$$= S.\ ({}_sp_x.R_x) \div S({}_cp_x.R_x)$$

The indices I_x, q_x and R_x are connected by the relation:

$$\frac{\triangle I_x}{I_x} = \frac{\triangle q_x}{q_x} = \frac{\triangle R_x}{R_x}$$

That is to say:

$$\triangle \log I_x = \triangle \log q_x = \triangle \log R_x.$$

This means that:

(*a*) for *one and the same* distribution corresponding successive values of R_x, q_x and I_x are in the same proportions;

(*b*) with respect to distributions referable to *different* morbid conditions corresponding logarithmic increments or decrements of the three indices are in the same proportion.

The index q_x which we have used to compute R_x is equivalent to the ratio of the absolute specific rate of the age group x to the overall incidence (I_c) with respect to all age groups, since $I_c = T_c \div T_p$ and $q_x = c_x \div p_x = (C_x \div T_c) \div (P_x \div T_p)$. It follows that $c_x = p_x$ and $I_x = I_t$ when $q_x = 1$. In other words q_x is unity when: (*a*) the proportion of cases in a given age group is the same as the proportion of the population at risk in the same age group; (*b*) the incidence of the condition in the given age group is identical with its overall incidence. Thus values of q_x greater or less than unity respectively indicate a disproportionately high or low incidence in the age group concerned. When $q_x = 1$, $R_x = 100\ T_q^{-1} = Q$; and in general any value of q_x is obtainable by multiplying the corresponding value of R_x by the reciprocal of Q, so defined. Our present aim has been comparative, i.e. to exhibit age incidence distributions in such a way as to make explicit the trend of risk with respect to different diseases as age advances. For that purpose R_x is preferable to q_x. If the end in view is to ascertain whether a given age group contains a disproportionately high incidence of a particular condition our standard is Q, and values of R_x greater or less than Q signify respectively a disproportionately high or low incidence in the age group. Accordingly, we also give below values of Q for the distributions cited. Corresponding q_x distributions are obtainable by using the reciprocal of Q as a conversion factor.

Variance of R_x.—As defined above $R_x = 100(c_x \div p_x) \div S.(c_x \div p_x)$, and hence is the ratio of two quantities each involving c_x with sampling variance $V(c_x)$. The distribution of a quotient involving two quantities each liable to sampling error is not necessarily normal,* and the derivation of an appropriate expression for its

* Geary, R. C. (1930) *J. roy. Stat. Soc.*, **93**, 442.. (*The Frequency Distribution of the Quotient of two Normal Variates.*) Fieller, E. C. (1932) *Biometrika*, **24**, 428. (*The Distribution of the Index in a Normal Bivariate Population.*) Nicholson, C. (1941) *Biometrika*, **32**, 16. (*A Geometrical Analysis of the Frequency Distribution of the Ratio between two Variables.*)

variance is intricate; but in this context it seems legitimate to short-circuit difficulties which arise in the treatment of the general case. For the quantity defined by $q_x = c_x \div p_x$, in which the denominator is based on an exact population census, c_x alone is subject to sampling error, and the sampling variance of the ratio is given by:

$$V(q_x) = p_x^{-2} \cdot V(c_x) = q_x^2 (1-c_x) \div T_c . c_x$$

If we are concerned solely with comparison of relative liability to *one and the same* disease in different age groups, the only effect of dividing successive values of q_x by the sum $T_q = S.(q_x)$ is to change the scale, so that the distributions q_x for any disease are made isometric, successive values of R_x being in precisely the same ratio as corresponding values of q_x, and hence also the sampling errors of the same sets. It would therefore appear that we can then treat T_q as a constant, so that:

$$V(R_x) = \frac{100^2}{T_q^2} \cdot V(q_x)$$
$$= R_x^2 \cdot (1-c_x) \div T_c \cdot c_x$$

3. Relation of Age to Duration of Hospitalization

If a disease is normally treated in hospital, the patient's age at admission thereto provides the raw material of one class of data relevant to the delimitation of relative incidence (R_x), at onset, i.e. the case-age distribution (c_x). Our most reliable basic demographic data (*vide infra*) for assessing age risks refer to discharges on medical grounds rather than to hospitalization; and the age incidence distributions of such involve the relation of age to a certain level of *severity* as well as (or in contradistinction) to onset as such. Thus we are not entitled to expect a one to one relation between age-incidence distributions of discharges and hospital admissions unless the disease is such as would invariably and quickly lead to discharge from the service on medical grounds; and we have to entertain the possibility that administrative considerations relevant to the service prospects of younger or older patients may assign a different criterion of severity sufficient to justify the findings of a medical board. A wholly satisfactory yardstick of severity is not available. From a statistical viewpoint the only one which is generally applicable in this context is duration of stay in hospital. To the extent that we are entitled to rely on it, we have some means of deciding how far discrepancies between age distributions of discharges from the service and hospital admissions arise from the intrinsic relation of age to the gravity of a disease and its extrinsic relation to administrative policy *vis à vis* what degree of severity entitles the individual to release from service.

Hollerith tabulations of A.Fs. I.1220 provide us with a breakdown of diseases among Middle East troops (1943–4) by age and duration of stay in military hospitals. The figures cited below do not include stay in convalescent depot and are therefore not comparable with those used to assess total man-day wastage. They also suffer from a deficiency in so far as they do not include the entire period of

TABLE I

AVERAGE DURATION OF STAY IN HOSPITAL (DAYS) BY AGE; MALE OTHER RANKS; MIDDLE EAST; 1944

Diagnosis	<22	22-24	25-27	28-30	31-33	34-36	37-39	40-42	43-45	>45	All Ages	Sample Size
Appendicitis	26·5	27·4	29·1	28·9	26·2	29·7	28·2	33·9	27·6	33·0	28·2	680
Bronchitis	15·6	16·5	16·4	16·9	16·4	16·0	18·1	17·1	22·2	21·9	16·9	1,812
Burns	30·3	28·3	33·2	25·9	28·7	33·6	31·4	35·4	39·7	18·6	30·3	545
Common cold	9·9	9·5	9·3	10·1	9·8	9·1	10·6	8·9	12·1	10·3	9·7	1,807
Conjunctivitis	24·8	25·4	19·0	23·8	22·2	27·4	28·9	19·2	18·5	16·0	23·6	404
*Cystitis and pyelitis	30·7	25·2	22·1	25·4	26·4	24·4	23·9	35·8	54·8	33·0	25·6	586
Diphtheria (fauc., laryn. and nasal)	50·5	49·8	45·7	51·2	49·0	43·7	51·3	44·6	—	—	49·0	254
*Dysentery—Flexner	14·5	14·2	15·1	13·8	15·0	15·9	16·4	15·0	27·1	26·0	14·9	549
Dysentery amoebic	34·3	37·0	41·1	43·0	37·5	38·2	36·8	36·4	46·0	26·0	39·4	498
Dysentery and diarrhoea (unspecified)	13·9	13·8	14·3	14·0	14·7	14·4	14·6	13·5	16·9	14·9	14·3	4,362
Dyspepsia and gastritis	12·0	15·1	16·6	17·4	17·0	18·1	21·3	18·1	25·1	24·4	17·6	972
*Foot deformities	28·6	25·8	25·1	26·6	30·7	30·5	24·7	19·7	21·0	17·5	26·7	554
Gonorrhoea	31·7	25·5	20·8	22·0	22·2	24·1	24·3	18·9	10·9	—	23·3	914
Haemorrhoids	18·2	23·8	19·4	23·5	21·5	25·7	24·6	26·7	22·9	24·2	23·1	823
Hernia	42·5	38·4	36·0	37·1	40·4	39·7	38·4	36·7	31·9	31·6	38·3	721
*Internal derangement of knee	40·2	33·2	30·9	30·9	39·2	26·8	30·3	25·3	32·0	19·0	32·6	580
Impetigo	24·2	22·5	23·8	21·6	22·3	22·7	20·5	18·5	16·5	12·2	22·5	1,014
Infective hepatitis	27·3	27·9	29·0	30·8	32·3	33·0	40·1	40·1	30·1	40·4	30·3	1,948
Influenza	18·6	11·8	11·6	11·9	11·6	12·9	11·0	10·6	12·5	—	12·2	253
Injuries, *not* enemy action (excl. burns)	30·5	35·4	34·3	32·7	35·9	34·5	37·8	36·1	38·3	41·2	34·7	2,790
Keratitis	40·1	31·4	35·9	27·5	29·8	31·3	25·9	32·3	24·6	17·0	31·2	273
*Leishmaniasis—cutaneous	28·9	34·4	25·9	26·7	22·9	30·2	15·8	28·9	—	—	28·1	256
Malaria—B.T.	16·4	16·2	16·6	15·9	16·5	16·2	17·3	18·8	20·0	20·1	16·5	7,545
„ —M.T.	16·5	17·3	15·5	17·7	26·8	17·6	22·2	19·1	23·5	11·0	18·5	416
*Mumps	18·2	18·5	18·7	19·4	22·0	19·3	21·4	—	—	27·0	19·5	119
*Neoplasms—malignant	19·8	31·2	37·6	50·5	33·3	58·6	37·5	50·5	47·0	65·5	42·2	123
*Nephritis	34·6	60·2	58·9	38·9	48·9	49·6	33·8	53·0	27·0	19·5	48·7	164
Otitis externa	18·8	13·6	16·0	15·9	16·5	15·8	14·6	16·9	13·0	13·5	15·7	567
Otitis media	23·4	25·2	25·4	25·9	22·9	26·9	25·9	37·5	35·0	14·0	25·5	902
*Peptic ulcer—gastric	51·6	55·7	52·5	49·4	61·4	51·3	55·1	41·1	12·0	57·8	52·6	121
Peptic ulcer—duodenal	67·8	63·6	63·5	62·0	65·9	50·5	53·9	62·3	50·4	56·2	59·1	232
Pneumonia—lobar	32·7	28·6	32·5	31·0	30·9	38·0	29·2	45·3	39·3	2·0	32·0	486
*Pneumonia—secondary	24·2	28·6	26·9	24·2	27·3	25·9	27·5	27·6	47·7	28·0	26·7	414

Psychiatric disorders: Psychosis ..	75·7	68·0	67·9	72·1	65·2	79·6	88·6	42·8	64·1	44·5	70·9	244
Psycho-neurosis	26·0	33·5	35·4	34·1	34·4	38·1	34·5	42·7	34·9	28·0	34·9	1,469
Psycho-pathic personality ..	57·5	53·3	46·7	52·9	57·5	68·9	38·4	41·4	27·0	32·5	52·7	184
*Rheumatism articular ..	58·2	38·2	34·4	30·5	36·3	30·2	27·8	35·0	43·1	36·8	33·6	380
Rheumatism —non-articular ..	20·2	16·5	17·1	22·0	19·8	20·9	22·0	21·9	23·9	26·4	20·3	869
Sandfly fever	9·0	8·2	8·2	8·6	8·5	8·6	8·2	8·5	8·7	6·4	8·4	1,731
Scabies ..	10·8	10·0	12·1	11·3	11·8	10·4	10·8	17·0	5·6	9·0	11·2	569
Sinusitis ..	20·7	22·2	19·5	19·1	17·1	18·7	24·2	20·8	18·2	14·0	20·0	451
*Synovitis and arthritis ..	38·7	28·5	28·3	32·8	33·7	39·6	31·4	28·2	34·0	17·5	31·9	674
Syphilis—early	20·6	23·4	21·7	22·3	23·9	23·3	25·9	28·7	28·8	31·9	23·3	478
Tonsillitis and pharyngitis	12·8	11·5	11·5	11·8	11·7	12·0	11·4	13·2	16·7	13·7	11·9	5,605
*Typhoid ..	77·9	69·9	68·8	64·3	70·2	56·0	77·3	67·3	88·5	—	69·0	244
Varicose veins	19·6	23·0	21·8	22·0	23·1	25·3	25·4	25·3	25·1	42·5	23·2	646

* 1943 and 1944.

hospitalization of a small proportion of extremely serious cases evacuated from the theatre.

It is admissible that duration of stay is a crude yardstick of the gravity of a disease, but there is little doubt about the conclusions to which its use leads us, if we have to rely on it as the best tool at our disposal. The results in Tables I and II refer only to diseases of which samples sufficiently large to yield statistically clear-cut evidence are available; and they are sufficiently clear-cut to admit of little dubiety. With few exceptions, relative rates for successive age groups shown on a percentage scale in Table II do not depart widely from the 10% level. That is to say, age of the patient does not conspicuously influence the duration of stay in hospital. The exceptions to this rule are: (a) diseases (e.g. *impetigo*) for which we do not have to rely on data referable to discharge from service; (b) conditions (e.g. *I.D.K.*) which are not singular clinical entities; (c) diseases (e.g. *malignant neoplasms*) which either lead to speedy discharge or to death after prolonged treatment in hospital.

4. Relation of Age to Medical Discharge

Discharge from the Army on medical grounds takes place on the recommendation of medical boards sitting only in the United Kingdom, and the relevant documentary data refer to the whole Army. Hence data with respect to medical discharges are referable to a population whose precise age composition we know. Large samples are not available with respect to some hospitalized diseases, more particularly communicable conditions from which the patient normally makes a good recovery. Even when large samples of both are in fact available, we are not

TABLE II

RELATIVE DURATION OF STAY IN HOSPITAL BY AGE; MALE OTHER RANKS; MIDDLE EAST; 1944

Diagnosis	<22	22-24	25-27	28-30	31-33	34-36	37-39	40-42	43-45	>45	Total	Sample Size
Appendicitis	9·1	9·4	10·0	9·9	9·0	10·2	9·7	11·7	9·5	11·4	100·0	680
Bronchitis	8·8	9·3	9·3	9·5	9·3	9·0	10·2	9·7	12·5	12·4	100·0	1,812
Burns	9·9	9·3	10·9	8·5	9·4	11·0	10·3	11·6	13·0	6·1	100·0	545
Common cold	9·9	9·5	9·3	10·1	9·8	9·1	10·6	8·9	12·1	10·3	100·0	1,807
Conjunctivitis	11·0	11·3	8·4	10·6	9·9	12·2	12·8	8·5	8·2	7·1	100·0	404
*Cystitis and pyelitis	10·2	8·4	7·3	8·4	8·8	8·1	7·9	11·9	18·2	10·9	100·0	586
Diphtheria (fauc., laryn. and nasal)	13·1	12·9	11·8	13·3	12·7	11·3	13·3	11·6	—	—	100·0	254
*Dysentery—Flexner	8·4	8·2	8·7	8·0	8·7	9·2	9·5	8·7	15·7	15·0	100·0	549
Dysentery—amoebic	9·1	9·8	10·9	11·4	10·0	10·2	9·8	9·7	12·2	6·9	100·0	498
Dysentery and diarrhoea (unspecified)	9·6	9·5	9·9	9·7	10·1	9·9	10·1	9·3	11·7	10·3	100·0	4,362
Dyspepsia and gastritis	6·5	8·2	9·0	9·4	9·2	9·8	11·5	9·8	13·6	13·2	100·0	972
*Foot deformities	11·4	10·3	10·0	10·6	12·3	12·2	9·9	7·9	8·4	7·0	100·0	554
Gonorrhoea	15·8	12·7	10·4	11·0	11·1	12·0	12·1	9·4	5·4	—	100·0	914
Haemorrhoids	7·9	10·3	8·4	10·2	9·3	11·1	10·7	11·6	9·9	10·5	100·0	823
Hernia	11·4	10·3	9·7	10·0	10·8	10·7	10·3	9·8	8·6	8·5	100·0	721
*Internal derangement of knee	13·1	10·8	10·0	10·0	12·7	8·7	9·8	8·2	10·4	6·2	100·0	580
Impetigo	11·8	11·0	11·6	10·5	10·9	11·1	10·0	9·0	8·1	6·0	100·0	1,014
Infective hepatitis	8·2	8·4	8·8	9·3	9·8	10·0	12·1	12·1	9·1	12·2	100·0	1,948
Influenza	16·5	10·5	10·3	10·6	10·3	11·5	9·8	9·4	11·1	—	100·0	253
Injuries, *not* enemy action (excl. burns)	8·6	9·9	9·6	9·2	10·1	9·7	10·6	10·1	10·7	11·6	100·0	2,790
Keratitis	13·6	10·6	12·1	9·3	10·1	10·6	8·8	10·9	8·3	5·7	100·0	273
*Leishmaniasis—cutaneous	13·5	16·1	12·1	12·5	10·7	14·1	7·4	13·5	—	—	100·0	256
Malaria—B.T.	9·4	9·3	9·5	9·1	9·5	9·3	9·9	10·8	11·5	11·6	100·0	7,545
,, —M.T.	8·8	9·2	8·3	9·5	14·3	9·4	11·9	10·2	12·6	5·9	100·0	416
*Mumps	11·1	11·2	11·4	11·8	13·4	11·7	13·0	—	—	16·4	100·0	119
*Neoplasms—malignant	4·6	7·2	8·7	11·7	7·7	13·6	8·7	11·7	10·9	15·2	100·0	123
*Nephritis	8·2	14·2	13·9	9·2	11·5	11·7	8·0	12·5	6·4	4·6	100·0	164
Otitis externa	12·2	8·8	10·3	10·3	10·7	10·2	9·4	10·9	8·4	8·7	100·0	567
Otitis media	8·9	9·6	9·7	9·9	8·7	10·3	9·9	14·3	13·4	5·3	100·0	902
*Peptic ulcer—gastric	10·6	11·4	10·8	10·1	12·6	10·5	11·3	8·4	2·5	11·8	100·0	121
Peptic ulcer—duodenal	11·4	10·7	10·7	10·4	11·1	8·5	9·0	10·5	8·5	9·4	100·0	232
Pneumonia—lobar	10·6	9·2	10·5	10·0	10·0	12·3	9·4	14·6	12·7	0·6	100·0	486
*Pneumonia—secondary	8·4	9·9	9·3	8·4	9·5	9·0	9·6	9·6	16·6	9·7	100·0	414

Psychiatric disorders: Psychosis ..	11·3	10·2	10·2	10·8	9·8	11·9	13·3	6·4	9·6	6·7	100·0	244
Psycho-neurosis..	7·6	9·8	10·4	10·0	10·1	11·2	10·1	12·5	10·2	8·2	100·0	1,469
Psycho-pathic personality ..	12·1	11·2	9·8	11·1	12·1	14·5	8·1	8·7	5·7	6·8	100·0	184
*Rheumatism—articular	15·7	10·3	9·3	8·2	9·8	8·2	7·5	9·4	11·6	9·9	100·0	380
Rheumatism—non-articular ..	9·6	7·8	8·1	10·4	9·4	9·9	10·4	10·4	11·3	12·5	100·0	869
Sandfly fever	10·9	9·9	9·9	10·4	10·3	10·4	9·9	10·3	10·5	7·7	100·0	1,731
Scabies ..	9·9	9·2	11·1	10·4	10·8	9·6	9·9	15·6	5·1	8·3	100·0	569
Sinusitis ..	10·6	11·4	10·0	9·8	8·8	9·6	12·4	10·7	9·4	7·2	100·0	451
*Synovitis and arthritis ..	12·4	9·1	9·1	10·5	10·8	12·7	10·0	9·0	10·9	5·6	100·0	674
Syphilis—early	8·2	9·3	8·7	8·9	9·5	9·3	10·3	11·5	11·5	12·7	100·0	478
Tonsillitis and pharyngitis	10·1	9·1	9·1	9·3	9·3	9·5	9·0	10·5	13·2	10·8	100·0	5,605
*Typhoid ..	12·2	10·9	10·7	10·0	11·0	8·7	12·1	10·5	13·8	—	100·0	244
Varicose veins	7·7	9·1	8·6	8·7	9·1	10·0	10·0	10·0	9·9	16·8	100·0	646

* 1943 and 1944.

necessarily entitled to assume that discharge and hospitalization data are comparable. It is therefore necessary to be explicit about when such an assumption is permissible. If a disease sufficiently severe to incur hospitalization is also sufficiently severe to incur medical discharge, age distributions based on the two sources of material should tally. When this is not true, they may fail to do so for either or both of two reasons: (*a*) a level of severity sufficient to incur discharge may itself be a function of age; (*b*) administrative considerations relevant to the utilization of man-power at different ages may influence criteria of severity adopted by a medical board.

Data set forth in this section refer to diseases collectively responsible for about 75% of all discharges from the Army on medical grounds during the years 1943 alone, or 1943 and 1944 together. With two significant exceptions, schizophrenia and tuberculosis, diseases with a fairly clear-cut differential diagnosis show a characteristic trend, with a peak at the latter end of the age range, as is notably true of chronic bronchitis, peptic ulcer, malignant neoplasms, dyspepsia and gastritis, diabetes mellitus, sciatica, manic depressive psychosis, and anxiety state (Fig. 2). For purposes of comparison our list also includes several conditions of diverse aetiology or uncertain differential diagnosis, more especially psychopathic personality, I.D.K. (internal derangement of knee), V.D.H. (valvular disease of the heart), and foot deformities. Otitis media appears among diseases listed because it ranks high as a reason for medical discharge from the service; but the distribution based thereon is not strictly comparable with a distribution based on all hospital admissions. The bulk of cases recommended for discharge from the Army are chronic. We might therefore expect the age-incidence distribution of

such cases to correspond with that of hospital admissions for chronic cases only. This is not so. Whereas the incidence of hospitalized cases of chronic otitis media is about the same in all age groups, discharge rates rise steadily with advancing age. How far the difference is due to greater gravity of the disease as age advances, and how far to greater readiness of medical boards to recommend for discharge chronic cases of long standing in the older age groups, is uncertain. A high relative specific rate for epilepsy in the youngest age group is almost certainly in large measure attributable to a high concentration of recent enlistments therein and has little or no biological significance. The higher incidence of schizophrenia in the younger age groups, and of manic depressive psychosis (Fig. 3) in the older, is in

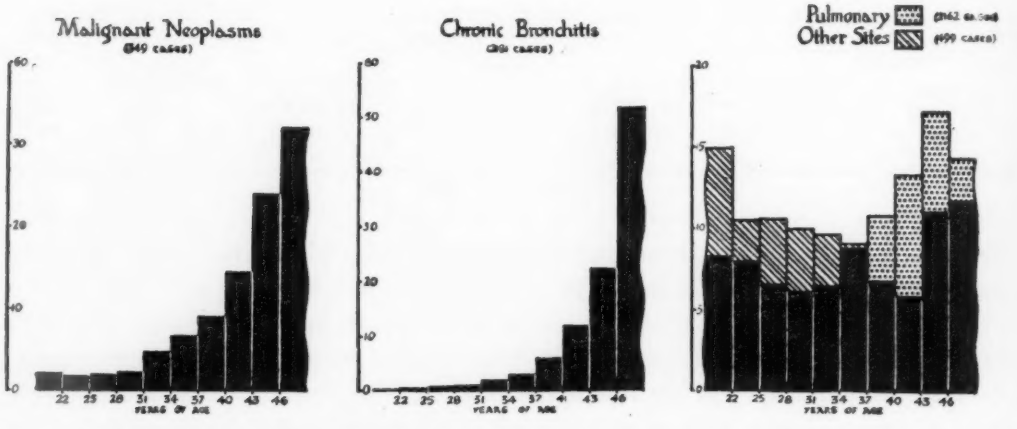

FIG. 2.—Relative age-incidence distributions of (*a*) malignant neoplasms (349 cases), (*b*) chronic bronchitis (2,181 cases), and (*c*) tuberculosis based on medical discharges of male other ranks. The figure on the right shows superimposed histograms based on 2,162 cases of pulmonary and 499 cases of tuberculosis at other sites. The overlapping portions are black, excess of pulmonary tuberculosis dotted, and excess of tuberculosis at other sites shaded.

concord with general knowledge; and since these conditions commonly incur discharge from service when recognized as such, we may regard the distribution cited as a representative picture of the relation of age to incidence. This is conspicuously true of peptic ulcers. Superimposed histograms of discharge distributions with respect to duodenal and gastric ulcer (extreme right of Fig. 4) present a picture which tallies closely with comparison of distribution based on hospitalization data (*vide infra*), confirming a general clinical impression that: (*a*) the age of onset of duodenal ulcer is somewhat earlier than that of gastric ulcer; (*b*) whereas the incidence of the latter increases steeply over the whole age group, that of duodenal ulcer has its peak in the quinquennium 40–45, declining thereafter.

Broadly speaking, age incidence distributions for males (Table III) and females (Table IV) tally closely. Two differences call for comment. One is a relative excess of female discharges with respect to manic depressive psychosis and anxiety state in the menopausal age group. The other invites comparison with statistics

of the civil population. Among women (auxiliaries), age variation with respect to the discharge rate for pulmonary tuberculosis is in accordance with the general

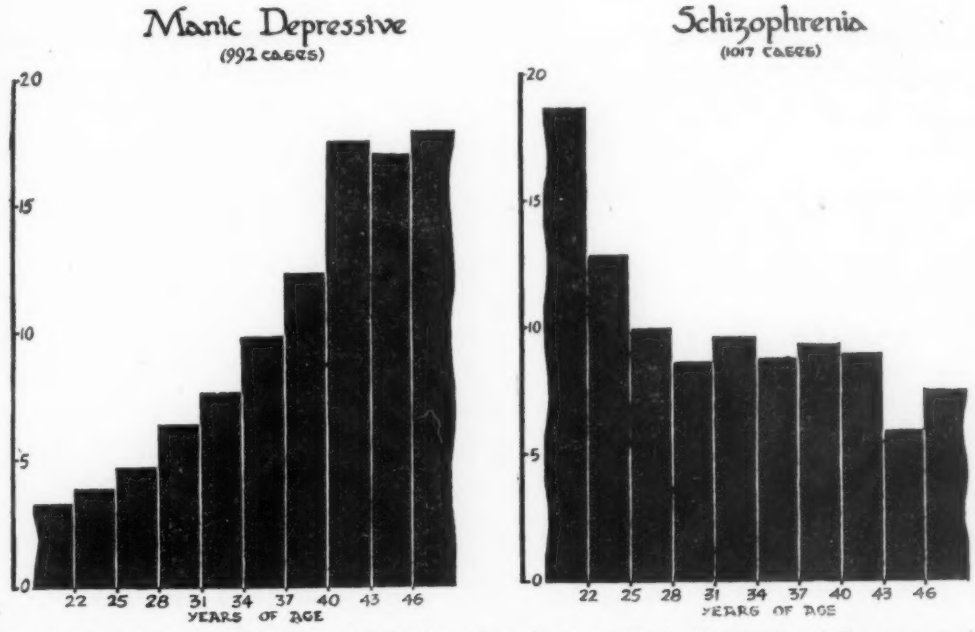

FIG. 3.—Relative age-incidence distributions based on medical discharges of the two major psychoses, manic-depressive (992 male cases) on the left, and schizophrenia (1,017 male cases) on the right.

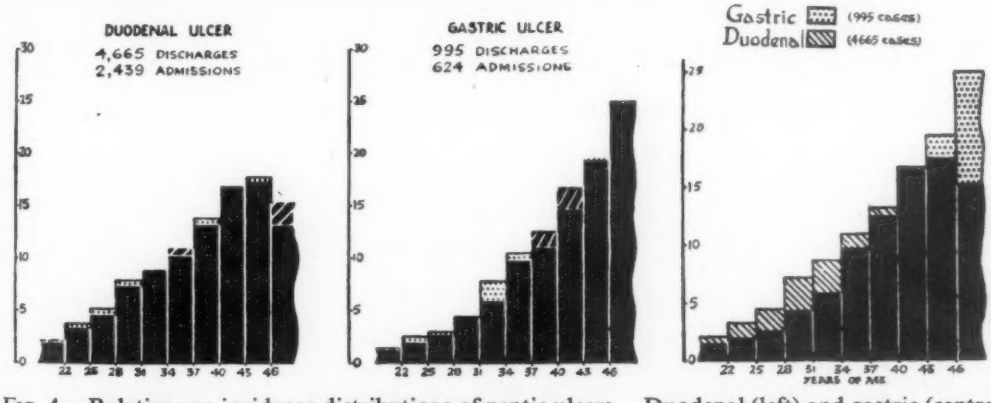

FIG. 4.—Relative age-incidence distributions of peptic ulcers. Duodenal (left) and gastric (centre). Histograms based on medical discharges and on hospital admissions superimposed with overlapping regions black, excess of discharges shaded, and excess of hospital admissions dotted. Right, superimposed histograms of gastric and duodenal ulcer, both based on medical discharges, overlapping regions black, excess of gastric ulcer dotted, and excess of duodenal ulcer shaded.

rule for infectious diseases. The younger are most affected. The distribution among males, on the other hand, shows a significant secondary rise after the age of 33, a

contrast which is reinforced by the exclusion from both samples of cases of pleurisy with effusion. This is in keeping with mortality figures for England and Wales

TABLE III

RELATIVE AGE-INCIDENCE DISTRIBUTIONS OF DISCHARGES FROM THE ARMY ON MEDICAL GROUNDS; MALE OTHER RANKS

	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Sample Size	Q
Bronchitis—chronic ..	0·34	0·49	0·75	1·11	2·07	2·98	5·83	12·01	22·45	51·97	100·00	2,181	2·45
Asthma ..	5·70	3·83	5·35	8·01	8·10	10·22	10·66	14·72	16·95	16·45	100·00	543	7·21
Gastric ulcer ..	1·51	1·98	2·71	4·34	5·90	9·75	12·61	16·71	19·38	25·12	100·00	995	5·17
Duodenal ulcer	2·21	3·33	4·59	7·35	8·78	10·96	13·21	16·76	17·49	15·30	100·00	4,665	6·74
Peptic ulcers—all	2·06	3·03	4·15	6·63	8·13	10·62	13·08	16·92	17·98	17·41	100·00	5,843	6·38
Dyspepsia and gastritis ..	0·85	1·05	2·11	2·77	3·91	5·66	8·81	12·16	20·12	42·55	100·00	487	3·69
Otitis media ..	5·65	5·51	6·53	8·15	9·40	9·46	8·73	12·49	14·31	19·75	100·00	1,305	7·64
*T.B. pulmonary (excl. pleurisy)	8·81	8·02	7·72	6·80	6·70	8·26	9·56	11·08	16·02	17·03	100·00	4,700	8·12
*T.B. pulmonary	11·20	8·70	8·03	6·92	6·70	7·88	9·01	10·55	14·78	16·23	100·00	5,713	8·53
*T.B. other sites	16·18	10·27	10·40	10·09	8·12	8·52	8·72	7·57	9·58	10·55	100·00	968	10·42
*T.B. all ..	11·81	8·90	8·32	7·30	6·88	7·96	8·97	10·20	14·16	15·50	100·00	6,681	8·76
Neoplasms—malignant ..	2·06	1·73	1·99	2·31	4·81	6·75	9·23	14·61	24·20	32·32	100·00	349	4·18
Neoplasms—Benign and unspecified ..	3·87	3·76	3·47	8·27	3·16	8·25	9·60	14·60	18·69	26·32	100·00	100	5·86
Valvular disease of the heart	9·67	7·70	7·76	7·18	8·04	8·53	11·82	13·81	13·01	12·48	100·00	777	8·61
Foot deformities	3·20	2·22	3·44	5·15	7·91	11·00	10·94	15·79	16·45	23·90	100·00	613	5·93
Nephritis ..	5·91	4·38	4·72	6·85	6·71	5·92	13·03	14·46	18·49	19·53	100·00	268	6·66
*Hernia ..	0·39	0·31	0·47	1·24	1·67	2·91	5·31	10·04	14·56	63·10	100·00	367	2·06
*Internal derangement of knee ..	3·69	5·58	8·16	9·62	11·51	11·60	12·54	12·03	10·65	14·60	100·00	431	8·59
*Diabetes mellitus ..	5·01	5·66	6·31	6·11	4·94	7·41	7·67	11·57	17·17	28·15	100·00	507	6·50
*Disseminated sclerosis ..	4·15	5·53	4·96	8·94	12·93	11·22	9·76	15·53	6·10	20·89	100·00	237	8·13
Sciatica ..	1·41	1·90	2·32	3·42	5·95	7·96	12·44	20·36	18·91	25·31	100·00	413	4·90
*Epilepsy ..	21·50	10·40	8·87	8·38	8·70	8·74	8·99	10·55	9·11	4·76	100·00	2,224	10·85
Mental deficiency	14·73	6·06	5·75	5·84	5·88	7·86	9·58	15·18	14·96	14·16	100·00	1,098	8·13
Anxiety state ..	2·91	3·54	4·57	5·71	7·11	9·09	11·04	16·00	19·33	20·70	100·00	6,325	6·14
Psychopathic personality ..	12·13	8·21	7·70	8·23	7·58	8·57	9·58	11·27	15·45	11·28	100·00	2,774	8·96
Manic depressive psychosis ..	3·24	3·83	4·68	6·33	7·61	9·83	12·27	17·44	16·91	17·86	100·00	992	6·57
Hysteria ..	8·68	5·01	5·36	6·36	8·00	9·33	10·76	15·07	19·07	12·36	100·00	3,282	7·53
Schizophrenia ..	18·66	12·84	9·89	8·63	9·60	8·79	9·28	8·92	5·89	7·49	100·00	1,017	11·30
*Paranoid state	0·21	1·16	1·25	4·72	4·19	5·66	11·18	14·23	31·94	25·45	100·00	140	4·17
Obsessional state	4·41	5·89	8·32	8·14	8·24	7·96	15·32	12·95	21·30	7·47	100·00	237	7·91

* Sample includes 1944 cases.

which show age distributions with a peak in middle life some 20 years earlier for females than for males. Within the age-range of the Army population, therefore, civilian mortality experience tallies with the results exhibited in Tables III and IV.

Further available evidence[1] suggests that excess pulmonary tuberculosis among males of middle life is caused by the additional industrial risks to which they are subject.

TABLE IV

RELATIVE AGE-INCIDENCE DISTRIBUTIONS OF DISCHARGES FROM THE ARMY ON MEDICAL GROUNDS; FEMALES (A.T.S. AUXILIARIES)

	<22	22–24	25–27	28–30	31–33	34–36	37–39	>39	Total	Sample Size	Q
*Bronchitis—chronic	1·78	1·76	4·00	4·96	11·96	6·25	23·99	45·32	100·00	135	3·40
*Peptic ulcers—all	4·28	3·73	5·39	15·04	7·20	10·54	28·32	25·49	100·00	129	5·48
*T.B. pulmonary (excl. pleurisy)	19·42	16·93	17·50	16·63	10·76	13·15	3·30	2·31	100·00	493	17·35
*T.B. pulmonary	20·00	17·30	18·17	13·30	10·59	11·29	2·52	6·82	100·00	678	17·65
*T.B.—other sites	17·26	13·57	13·17	15·77	18·09	22·13	—	—	100·00	169	15·03
*T.B.—all	19·33	16·41	17·01	13·83	12·28	13·74	1·94	5·44	100·00	847	17·01
*Epilepsy	27·39	17·98	15·22	14·18	5·41	19·82	—	—	100·00	256	20·46
Mental deficiency	11·43	6·68	5·43	14·03	16·55	23·81	7·08	15·00	100·00	127	9·85
Anxiety state	2·80	3·90	5·14	8·84	11·14	16·47	22·38	29·34	100·00	636	4·74
*Psychopathic personality	9·28	5·85	9·44	11·23	14·42	20·00	13·83	15·94	100·00	823	8·54
*Manic depressive psychosis	5·41	5·25	7·84	13·07	13·24	15·77	18·60	20·83	100·00	345	6·73
Hysteria	8·55	5·89	9·67	9·51	16·85	18·16	16·13	15·24	100·00	426	8·41
*Schizophrenia	8·34	6·42	11·33	15·34	14·86	18·13	9·30	16·27	100·00	179	8·72

* Sample includes 1944 cases.

TABLE V

RELATIVE DISCHARGE RATES IN 6-YEAR AGE GROUPS DURING 1943 WITH RESPECT TO MALE OTHER RANKS

	Under 22	22–27	28–33	34–39	40–45	Over 45	All Ages
Psychiatric and nervous disorders	49·6	44·6	40·5	36·9	32·6	17·4	39·6
Peptic ulcers	5·8	11·4	16·1	16·7	13·8	6·5	13·3
Tuberculosis	12·5	10·3	5·8	5·1	3·8	2·0	7·0
Bronchitis	1·0	2·0	3·4	5·9	11·4	19·4	5·1
Otitis media	3·0	3·6	3·6	2·5	1·9	1·4	3·0
Asthma	1·3	1·2	1·5	1·2	1·0	0·5	1·2
Malignant neoplasms	0·5	0·5	0·7	1·0	1·2	1·1	0·8
Others	26·2	26·4	28·5	30·6	34·2	51·7	30·1
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0

Table V summarizes available data with respect to which diseases are more or less important as a source of permanent wastage in different age groups of the Army population. In the age group under 28, psychiatric and nervous disorders account for nearly half of all discharges. If we add peptic ulcers, tuberculosis,

[1] I.L.O. *Occupation and Health*, Geneva, 1934.

bronchitis, otitis media, and asthma, we have accounted for nearly 75% of all discharges within this age group; and of those included tuberculosis is by far the most noteworthy item in the age group under 22. In the 40–45 age group psychiatric and nervous disorders on the one hand, and diseases other than those mentioned above on the other, each account for almost exactly one-third of all discharges, and peptic ulcers together with bronchitis for a quarter. The age-group over 45 tells quite a different story. Bronchitis alone accounts for about one-fifth of all discharges. It is now a more important source of wastage than psychiatric and

TABLE VI

ANNUAL AGE STANDARDIZING FACTORS FOR DISCHARGE RATES; MALE OTHER RANKS

	1940	1941	1942	1943	1944		1940	1941	1942	1943	1944
Bronchitis —chronic	1·000	1·153	1·066	1·199	1·071	Nephritis	1·000	1·015	1·983	0·976	0·940
Asthma ..	1·000	0·979	0·929	0·915	0·880	Hernia ..	1·000	1·174	1·106	1·306	1·187
Gastric ulcer ..	1·000	0·977	0·859	0·844	0·810	Diabetes mellitus	1·000	1·022	1·005	1·028	1·006
Duodenal ulcer ..	1·000	0·928	0·828	0·804	0·758	Disseminated sclerosis	1·000	0·938	0·865	0·851	0·825
Peptic ulcer —all ..	1·000	0·937	0·834	0·811	0·763	Sciatica ..	1·000	0·996	0·871	0·851	0·784
Dyspepsia and gastritis	1·000	1·042	0·945	0·987	0·907	Anxiety state ..	1·000	0·975	0·896	0·885	0·839
T.B. pulmonary (excl. pleurisy)	1·000	1·037	1·045	1·053	1·046	Psychopathic personality ..	1·000	1·047	1·075	1·075	1·074
T.B. pulmonary	1·000	1·057	1·088	1·099	1·101	Manic depressive psychosis	1·000	0·967	0·885	0·867	0·824
T.B.—other sites ..	1·000	1·052	1·109	1·118	1·136	Hysteria ..	1·000	1·033	1·018	1·002	0·976
T.B.—all	1·000	1·056	1·091	1·102	1·106	Schizophrenia	1·000	1·074	1·140	1·146	1·174
Malignant neoplasms ..	1·000	1·055	0·965	0·977	0·902	Paranoid state ..	1·000	0·980	0·852	0·849	0·761
						Obsessional state ..	1·000	0·957	0·905	0·890	0·857

nervous disorders ; and diseases other than those specifically mentioned in this context now account for more than half the total discharges.

Broadly speaking we may thus summarize the experience of the war years:

(i) if the youngest age groups of an Army population predominate, the two chief sources of wastage are psychiatric disorders and tuberculosis;

(ii) if the middle age groups predominate, the two chief sources of wastage are psychiatric disorders and peptic ulcers;

(iii) if the oldest age group were to predominate, the two chief sources of wastage would be bronchitis and psychiatric disorders.

Since the age composition of the Army changed considerably between 1939

and 1945, conclusions presented in Tables III to V have a profound bearing on the interpretation of the trend of crude discharge rates during the war. Two main features of this change were: (i) a steady fall of the proportion of very young men; (ii) a concomitant decrease in the oldest (over 45) age group. The effect of this may be such as would wholly invalidate impressions gained from the trend of discharge rates with respect to individual diseases, if the risk of contracting them or the gravity of their manifestations rises or falls steadily as age advances. If the incidence of a disease increases very sharply only at the tail end of life the distortion is less conspicuous. Since the A.T.S. was at all times a younger population than male Army personnel, comparisons between crude discharge rates for women and men may give rise to even more erroneous conclusions than comparisons of discharge rates for the same class of personnel at different stages in

TABLE VII

ANNUAL AGE STANDARDIZING FACTORS FOR DISCHARGE RATES; A.T.S. AUXILIARIES

	(*a*) with respect to Military Strength, 1940				(*b*) with respect to A.T.S. Strength, 1941			
	1941	1942	1943	1944	1941	1942	1943	1944
Bronchitis—chronic	1·067	1·732	2·018	1·970	1·000	1·624	1·892	1·847
Peptic ulcers—all	1·048	1·329	1·442	1·435	1·000	1·268	1·375	1·369
T.B. pulmonary	0·965	0·899	0·899	0·915	1·000	0·932	0·932	0·949
T.B.—other sites	0·964	0·912	0·925	0·948	1·000	0·946	0·960	0·983
T.B.—all types	0·964	0·902	0·905	0·922	1·000	0·935	0·938	0·956
Anxiety state	1·144	1·571	1·677	1·615	1·000	1·373	1·465	1·411
Psychopathic personality	0·996	1·080	1·150	1·181	1·000	1·085	1·155	1·186
Manic depressive psychosis	1·050	1·250	1·315	1·297	1·000	1·191	1·253	1·235
Hysteria	1·008	1·105	1·169	1·190	1·000	1·097	1·161	1·181
Schizophrenia	1·023	1·120	1·176	1·180	1·000	1·095	1·150	1·154

the war. Tables VI and VII illustrate the magnitude of this source of erroneous comparison by citing appropriate standardizing factors. A single example will suffice to illustrate how gross errors may arise from comparison of crude rates on account of differences of age composition. The 1944 S.F. of A.T.S. auxiliaries (with respect to 1940 military strength) for peptic ulcers is 1·435. For the 1944 male population the corresponding S.F. is 0·763. To make the 1944 discharge rate of peptic ulcer among women comparable with that of males in the same year we have, therefore, to increase it in the ratio 1·435: 0·763, i.e. we have to multiply it by $1{\cdot}435 \div 0{\cdot}763 = 1{\cdot}9$. Thus age alone can suffice to account for a difference of nearly 1: 2.

5. RELATION OF AGE TO HOSPITAL ADMISSIONS IN THE UNITED KINGDOM

An obstacle to a wholly satisfactory analysis of hospital record cards as raw materials for the present objective has been the difficulty of obtaining a precise estimate of the populations at risk. Before re-organization of Army medical

statistics in the fall of 1944, need for age-strength distributions of the Army in each theatre was not recognized. Returns embodying the basic data were not in fact available until 1945. For the purpose of what follows, it has therefore been necessary to make an approximate estimate of the age structure of the United Kingdom population at risk during the years (1943 and 1944) for which the largest samples of data are available. In 1943 about 60% of the Army were still at home. As a first approximation (I) we might therefore take the 1943 age composition of the Army in the United Kingdom to be that of the Army as a whole in the same year. As a second approximation (II), we may estimate what the United Kingdom distribution would have been, if the only relevant selective process involved in dispatch of troops to overseas commands had been the exclusion of the age group under 19. Clearly, the first approximation underestimates the relative strength of the youngest Army age group in the United Kingdom and would, therefore, lead one to compute unduly high values of the relative incidence of diseases therein; but the alternative supposition takes no cognisance of the exclusion from overseas service of category "C" personnel among whom we have sufficient reasons to infer a preponderance of older age groups. An assessment based on this supposition therefore underestimates the size of the latter in the residual (United Kingdom) population, and would hence lead to unduly high relative specific rates in the older part of the age-range.

In fact, the computation of age incidence distributions for the diseases cited below on the basis of either approximation leads to results which do not greatly differ; and it is happily possible to arrive at an estimate (III) which is more plausible than either. With due consideration to the ratio of total home and overseas strengths, comparison between the separately *known* age-strength (1945) distributions of the Army in the United Kingdom and the Army as a whole, permits us to infer the age distribution of the segment of the Army population then excluded from overseas service above the age of 19. Presumably, this corresponds closely to the age distribution of personnel rejected on account of low medical category. Above the age of 22 this distribution is approximately parabolic. If we reject the age group under 19 as before, a quadratic formula convenient for computation leads to a fit good enough for the purpose in hand. The actual age distribution of the Army in the United Kingdom, March 1945, and the distribution computed by the formula are as follows:

U.K. 1945	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total
Calculated	21·2	9·9	12·2	12·7	12·5	11·1	9·2	6·2	3·3	1·7	100
Actual	20·9	10·2	12·6	13·4	12·6	10·7	8·6	5·9	3·4	1·7	100

Our third estimate (III) is based on the assumption that the age distribution of personnel rejected for overseas service as too young or of too low medical category

was in June 1943 approximately the same as in March 1945, in accordance with the formula used for computing the upper distribution of the preceding table. As shown below, the three estimates do not diverge grossly; and general conclusions stated in the text below are in fact consistent with distributions calculated on any of the three assumptions I–III specified.

Estimated U.K. 1943	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total
I	15·1	18·7	16·9	15·6	13·0	9·2	6·1	3·6	0·9	0·9	100
II	16·8	18·3	16·5	15·3	12·7	9·1	6·0	3·5	0·9	0·9	100
III	17·2	16·5	15·3	14·6	12·9	9·7	6·8	4·4	1·2	1·3	100

Table VIII is, in fact, based upon our third assumption which is undoubtedly preferable, but it will bring into focus how small is the order of error involved if we cite six distributions as calculated on assumptions I and III separately. The examples chosen illustrate descending, relatively flat, and ascending contours.

		<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total
Rubella	I	53·41	3·88	6·96	8·84	6·69	7·10	5·62	3·21	2·81	1·47	100
	III	50·50	4·76	8·23	10·25	7·22	7·36	5·34	2·89	2·31	1·15	100
Glandular fever	I	35·27	11·49	16·64	8·72	4·49	5·28	4·76	2·64	5·15	5·55	100
	III	32·45	13·59	19·28	9·71	4·72	5·27	4·44	2·36	4·16	4·02	100
T.B.— pulmonary	I	8·46	6·12	5·90	5·54	5·61	8·89	10·85	12·82	18·35	17·48	100
	III	8·50	7·92	7·42	6·75	6·50	9·67	11·08	12·17	15·92	14·08	100
Lobar pneumonia	I	13·42	4·92	4·49	5·78	5·56	7·56	9·34	7·63	11·34	29·98	100
	III	13·80	6·52	5·77	7·19	6·61	8·44	9·70	7·36	10·03	24·58	100
Gastric ulcer	I	1·21	1·91	2·34	3·49	6·46	9·14	10·29	14·64	21·24	29·28	100
	III	1·27	2·66	3·12	4·51	7·87	10·58	11·10	14·63	19·43	24·81	100
Chronic bronchitis	I	1·80	1·66	2·04	2·95	3·91	6·48	10·56	13·92	24·81	31·88	100
	III	1·95	2·31	2·77	3·90	4·87	7·64	11·59	14·21	23·18	27·59	100

It is possible to get a check on the above procedure for estimating the age structure of the male population by comparing age incidence distributions of discharges with those of hospital admissions so computed. With this end in view we have to rely on diseases which are (*a*) sufficiently common to yield large examples; (*b*) so severe as to lead to early discharge, when recognized.

So defined, the best "marker" diseases are peptic ulcers and pulmonary tuberculosis, as shown in Table IX, setting forth age-incidence distributions of male hospital admissions based on estimate III, side by side with age distributions of medical discharges. Specification of the appropriate female (A.T.S.) population at risk in each group offers no special difficulties, because the proportion of women serving overseas in 1943–4 was trivial.

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The most striking feature of Table VIII is the contrast between the age-incidence distributions of acute infections on the one hand and of non-communicable diseases or chronic infections on the other. With few exceptions discussed below, the general rule is that the incidence of acute infections falls off with increasing age and most steeply in the youngest age groups, as illustrated by the accompanying histogram of diphtheria (Fig. 5). To the extent that an attack confers more or less immunity, this is intelligible. The residual proportion not immunized by previous attack must then fall off in successive years of life, and the effective population at risk therefore becomes successively smaller than the total strength in a given age group. If this is a sufficient explanation of the phenomenon, two

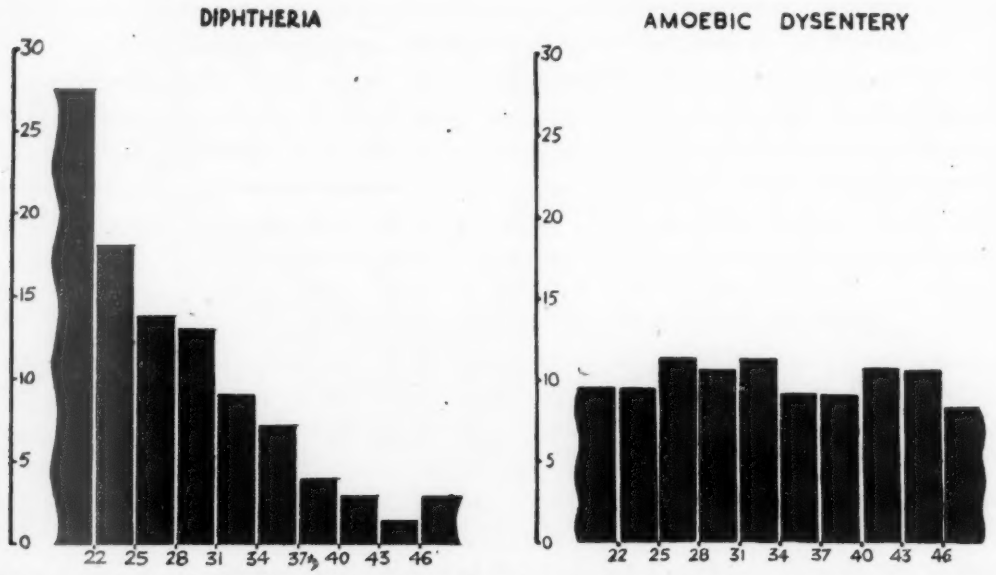

FIG. 5.—Relative age-incidence distributions based on hospital admissions of 779 male cases of diphtheria in U.K. (left) and 1,501 male cases of amoebic dysentery (right) in Middle East.

conclusions follow. *Ceteris paribus*, the decline of incidence with advancing age should be: (*a*) less steep if the disease is more rare; (*b*) more steep if a *single* attack itself suffices to confer complete immunity, as is supposedly true of most virus diseases. It is therefore suggestive that: (i) rubella, measles, mumps and chickenpox show a steeper decline than other diseases listed; (ii) of these virus diseases, rubella—which is the most common—also shows the steepest fall; (iii) in contrast with the declining incidence of scarlet fever, the incidence of erysipelas—likewise a haemolytic streptococcal infection but one which confers little or no immunity—steadily increases as age advances. That gonorrhoea and syphilis also fall out of step with communicable diseases such as diphtheria, measles, or infective hepatitis, is what we should expect, since we know that an attack of gonorrhoea confers little or no immunity and that syphilitics treated early with arsenicals, can get a subsequent infection.

Since a single clear-cut difference, especially one putatively attributable to such a fundamental phenomenon as immunity, suffices to override any number of striking similarities when the identity of two conditions is under dispute, the age distributions of post-arsphenamine jaundice and infective hepatitis (Fig. 6) are particularly instructive in connexion with recent controversy arising from the discovery that the former is due to an icterogenic agent spread by imperfectly sterilized syringes. The distribution of infective hepatitis, here shown, confirms the general clinical impression that it is a disease to which younger age groups are specially prone. To that extent its behaviour is typical of communicable diseases. The age incidence

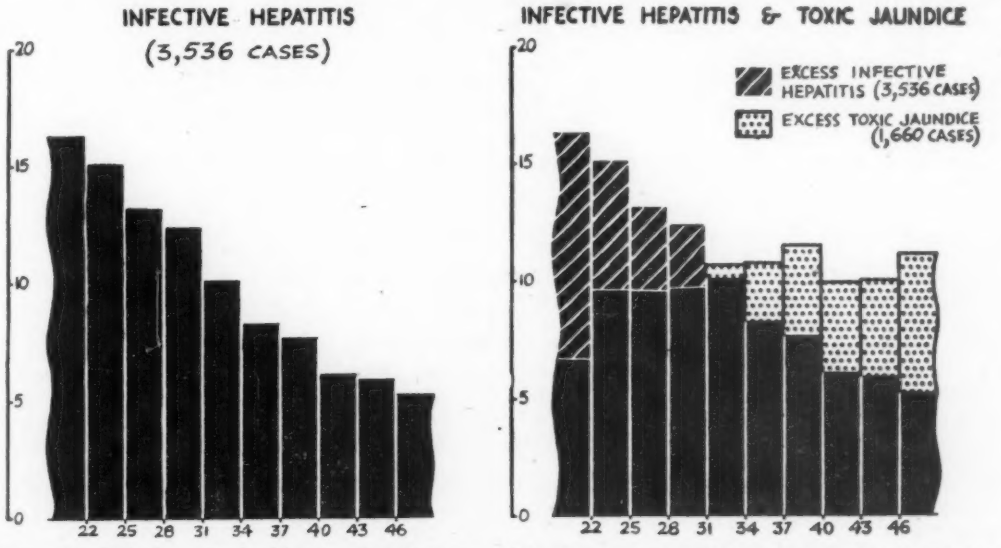

FIG. 6.—Relative age-incidence distributions of 3,536 male hospital admissions of infective hepatitis on the left; on the right, superimposed histograms of the foregoing and of post-arsphenamine jaundice among the syphilitic population (1,660 male cases). Excess of post-arsphenamine jaundice dotted, excess of infective hepatitis shaded.

distribution of post-arsphenamine jaundice (related to the correct population at risk, i.e. to syphilitics) is altogether different. This fact, as also the different seasonal distributions of the two diseases, is strong evidence against a recently prevalent belief that the same virus is responsible for both these conditions.

Exceptions to the general rule stated above, other than those mentioned, are scabies, pulmonary tuberculosis, and pneumonia. The first-named scarcely calls for comment, since its inclusion in the table as a communicable condition is merely a matter of convenience. Since death (or discharge) removes from the apparent population at risk individuals who might otherwise be immune to subsequent attack, the considerations advanced above do not apply to a wholly and rapidly fatal disease, and apply with less force to any disease which has a high fatality—as have tuberculosis and pneumonia. Even if this were not so, there are other reasons for anticipating the possibility that they would fall out of step with other infections. Since pulmonary tuberculosis is a protracted disease which may long remain latent,

TABLE VIII

RELATIVE AGE-INCIDENCE DISTRIBUTION OF ADMISSIONS TO HOSPITAL IN THE U.K.; MALE OTHER RANKS

	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Size of Sample	Q
A. Communicable Diseases:													
T.B. pulmonary (excl. pleurisy) ..	8·50	7·92	7·42	6·75	6·50	9·67	11·08	12·17	15·92	14·08	100·00	1,353	8·33
T.B. at other sites	17·63	10·19	8·65	10·84	10·19	9·42	8·11	6·90	10·19	7·89	100·00	435	10·99
T.B. all	10·27	8·41	7·62	7·62	7·17	9·65	10·45	11·07	14·79	12·93	100·00	1,788	8·86
Diphtheria ..	27·29	18·14	13·78	13·08	9·14	7·45	3·94	2·95	1·41	2·81	100·00	779	14·06
C.S.F.	27·96	8·63	4·83	9·44	6·56	13·12	10·01	2·42	17·03	—	100·00	217	11·51
Dysentery—bacillary ..	27·04	8·27	10·49	11·11	8·52	10·49	7·16	8·77	4·94	3·21	100·00	608	12·35
Chickenpox ..	38·16	11·06	13·48	9·65	6·38	8·94	4·96	4·68	2·70	—	100·00	411	14·18
Glandular fever ..	32·45	13·59	19·28	9·71	4·72	5·27	4·44	2·36	4·16	4·02	100·00	272	13·87
Measles	42·26	9·31	10·74	12·32	9·03	4·01	5·01	2·44	4·87	—	100·00	953	14·33
Mumps	34·78	10·05	10·05	12·23	8·42	7·74	6·66	5·71	2·17	2·17	100·00	984	13·59
Rubella	50·50	4·76	8·23	10·25	7·22	7·36	5·34	2·89	2·31	1·15	100·00	1,017	14·43
Scarlet fever ..	34·70	7·92	9·23	10·16	10·03	10·03	6·20	5·41	3·83	2·51	100·00	842	13·19
Tonsillitis	17·50	10·62	12·60	12·37	10·50	12·25	8·52	6·30	5·02	4·32	100·00	3,604	11·67
*Erysipelas ..	4·90	2·91	3·44	5·56	7·62	7·81	13·05	15·23	17·09	22·38	100·00	468	6·62
Otitis media—acute	21·01	13·54	9·87	13·29	10·76	10·25	9·11	6·71	2·78	2·66	100·00	731	12·66
„ —chronic ..	10·60	10·81	12·06	11·02	9·24	9·36	9·77	6·96	12·27	7·90	100·00	1,646	10·40
*Sinusitis—acute ..	18·17	6·80	13·27	12·37	7·36	11·71	7·80	8·36	3·01	11·15	100·00	249	11·15
„ —chronic ..	13·79	6·73	13·12	10·20	12·67	14·24	11·10	8·41	3·36	6·39	100·00	444	11·20
Pneumonia—lobar	13·80	6·52	5·77	7·19	6·61	8·44	9·70	7·36	10·03	24·58	100·00	1,819	8·36
„ —broncho	12·80	3·66	4·19	6·78	6·85	7·54	7·54	12·95	20·18	17·52	100·00	823	7·62
„ —virus ..	18·78	7·46	8·89	8·49	7·12	8·54	7·43	11·41	6·60	15·27	100·00	992	10·10
Infective hepatitis	16·28	15·07	13·12	12·39	10·09	8·26	7·65	6·08	5·83	5·22	100·00	3,536	12·15
†Post-arsphenamine jaundice.. ..	6·69	9·66	9·64	9·71	10·70	10·79	11·57	9·90	10·11	11·22	100·00	1,660	9·63
Syphilis—primary, early and secondary	8·32	11·64	10·91	12·68	10·19	9·88	9·24	8·52	10·19	8·42	100·00	2,717	10·40
Gonorrhoea—primary ..	7·97	15·15	13·02	13·02	11·00	9·43	9·09	7·07	8·98	5·27	100·00	10,675	11·22
Scabies	12·62	11·34	9·84	11·98	8·24	9·95	9·20	12·41	10·16	4·28	100·00	592	10·70
Impetigo	25·64	13·68	10·01	9·04	7·45	7·69	7·33	7·57	6·35	5·25	100·00	7,733	12·21
B. Disorders supposedly resulting from Infection:													
Nephritis—acute ..	10·58	9·04	7·51	9·22	6·31	8·45	4·95	6·23	16·38	21·33	100·00	126	8·53
„ —chronic ..	4·27	5·12	6·87	5·05	5·31	6·54	12·31	8·42	21·24	24·87	100·00	123	6·48
Rheumatic fever ..	23·18	12·29	10·50	11·14	13·19	9·73	6·02	9·48	2·30	2·18	100·00	461	12·80
C. Other Organic Disorders:													
Duodenal ulcer ..	2·01	3·87	5·30	8·03	8·82	10·32	13·84	16·85	17·78	13·19	100·00	2,439	7·71
Gastric ulcer ..	1·27	2·66	3·12	4·51	7·87	10·58	11·10	14·63	19·43	24·81	100·00	624	5·87
All peptic ulcer ..	1·91	3·55	4·72	7·25	8·48	10·32	13·19	16·27	18·05	16·27	100·00	3,215	6·28
Appendicitis ..	21·42	13·34	10·53	10·89	10·04	8·20	8·69	7·34	5·26	4·28	100·00	4,874	12·14
Chronic bronchitis	1·95	2·31	2·77	3·90	4·87	7·64	11·59	14·21	23·18	27·59	100·00	3,190	5·54
*Thyrotoxicosis ..	6·65	7·29	10·02	10·18	11·58	14·93	9·76	6·55	19·26	3·76	100·00	199	9·93
Asthma	8·54	4·81	6·05	8·96	10·53	8·13	9·70	13·93	18·08	11·28	100·00	925	8·25
Neoplasms (benign and unspecified)	11·63	6·37	7·94	8·59	8·86	10·71	10·06	11·91	11·82	12·10	100·00	2,887	9·23
* „ (malignant)	1·88	2·72	3·41	4·44	5·67	7·63	10·01	13·16	23·19	27·88	100·00	104	5·32
Hernia	12·37	7·63	7·39	8·42	9·46	11·02	12·32	12·15	11·03	8·22	100·00	6,868	9·67

D. Psychiatric and Nervous Disorders:													
Sciatica	1·72	2·68	4·67	7·55	9·47	11·05	12·83	16·68	18·94	14·41	100·00	1,462	6·86
Effort syndrome ..	8·46	4·94	6·20	7·12	8·63	11·47	13·07	15·91	14·66	9·55	100·00	553	8·38
Neurasthenia ..	6·69	7·05	2·98	11·84	10·85	14·38	11·84	15·91	9·31	9·13	100·00	78	9·04
Epilepsy	17·41	11·13	6·58	7·49	7·09	8·60	9·11	12·85	14·47	5·26	100·00	452	10·12
Obsessive psychoneurosis ..	3·96	10·63	12·08	11·67	10·83	14·48	15·10	10·31	10·94	—	100·00	231	10·42
Schizophrenia ..	21·18	15·39	9·85	9·48	9·48	10·34	8·13	8·13	5·42	2·59	100·00	728	12·32
Paranoid state ..	0·44	1·33	1·43	3·95	7·36	6·02	11·65	21·63	17·58	28·59	100·00	68	4·94
Psychopathic personality ..	13·90	11·07	10·53	11·40	9·55	8·36	9·77	10·64	10·64	4·13	100·00	1,488	10·86
Manic depressive psychosis ..	4·25	6·14	6·85	7·95	8·43	9·84	12·13	15·59	15·83	12·99	100·00	1,004	7·87
Anxiety state ..	5·83	7·92	8·93	9·74	10·11	10·75	12·02	13·11	13·93	7·65	100·00	6,458	9·11
Hysteria	15·03	10·05	8·68	9·42	10·79	9·52	10·16	9·21	10·79	6·35	100·00	2,908	10·58

* Sample includes 1944 cases. † Strength used was the age-distribution of syphilis cases.

becoming manifest at a late stage under conditions of stress, we cannot assume that an age distribution based on the time at which diagnosis takes place tallies closely with an age distribution based on the time at which infection actually occurs. Lobar pneumonia, which also has a relatively high fatality rate, is attributable to a variety of distinguishable types and of strains within one and the same type; and secondary pneumonias constitute an even more heterogeneous assemblage. It is therefore arguable that exceptions to the rule stated are more apparent than real; and that they are, indeed, the class of exceptions that prove the rule.

Of diseases which oppress the younger age groups most, two on our list, namely appendicitis and schizophrenia, do not come within the class of communicable conditions. A possible explanation of the age distribution of the first is in line with the one offered above. Appendicectomy is now a relatively common practice; and like immunity implies the build-up of a residual population incapable of subsequent attack. The characteristic distribution of schizophrenia is intelligible if we regard it as a congenital disposition of which the diagnosis depends in large measure on failure of the subject to fulfil new social demands imposed by adult life.

Of two diseases supposedly due to infection, rheumatic fever conforms to the general rule stated above. Evidence concerning the origin of acute nephritis is more conflicting. Its singularity as a clinical entity is more dubious, and its age distribution is not typical of communicable diseases in general. Remaining organic disorders listed include: peptic ulcers, malignant neoplasms, chronic bronchitis, asthma, hernia and benign neoplasms. The incidence of gastric ulcer and chronic bronchitis increases steeply with advancing age to the limit of the range. That of duodenal ulcer initially increases more steeply than that of gastric ulcer, but attains a peak about 44 years of age. Fig. 4 shows the use of the peptic ulcers as marker diseases in the sense already defined. The close correspondence between distributions based on medical discharges and hospital records provides a satisfactory check on the demographic estimates employed in the treatment of data derived from the latter.

TABLE IX

COMPARISON OF RELATIVE AGE-INCIDENCE DISTRIBUTIONS OF ADMISSIONS TO HOSPITAL IN U.K. AND OF DISCHARGES FROM THE ARMY ON MEDICAL GROUNDS; MALE OTHER RANKS

	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Size of Sample
All Diseases :												
Admissions	11·20	8·89	8·42	9·62	9·11	9·65	10·22	10·02	12·42	10·47	100·00	
Discharges	4·30	3·42	3·77	4·36	5·43	6·73	8·64	12·81	17·95	32·39	100·00	
A. **Communicable Diseases:**												
T.B. pulmonary (excl. pleurisy)												
Admissions	8·50	7·92	7·42	6·75	6·50	9·67	11·08	12·17	15·92	14·08	100·00	1,353
*Discharges	8·81	8·02	7·72	6·80	6·70	8·26	9·56	11·08	16·02	17·03	100·00	4,700
T.B. at other sites												
Admissions	17·63	10·19	8·65	10·84	10·19	9·42	8·11	6·90	10·19	7·89	100·00	435
*Discharges	16·18	10·27	10·40	10·09	8·12	8·52	8·72	7·57	9·58	10·55	100·00	968
C. **Other Organic Disorders:**												
Duodenal ulcer												
Admissions	2·01	3·87	5·30	8·03	8·82	10·32	13·84	16·85	17·78	13·19	100·00	2,439
Discharges	2·21	3·33	4·59	7·35	8·78	10·96	13·21	16·76	17·49	15·30	100·00	4,665
Gastric ulcer												
Admissions	1·27	2·66	3·12	4·51	7·87	10·58	11·10	14·63	19·43	24·81	100·00	624
Discharges	1·51	1·98	2·71	4·34	5·90	9·75	12·61	16·71	19·38	25·12	100·00	995
All peptic ulcers												
Admissions	1·91	3·55	4·72	7·25	8·48	10·32	13·19	16·27	18·05	16·27	100·00	3,215
Discharges	2·06	3·03	4·15	6·63	8·13	10·62	13·08	16·92	17·98	17·41	100·00	5,843
Chronic bronchitis												
Admissions	1·95	2·31	2·77	3·90	4·87	7·64	11·59	14·21	23·18	27·59	100·00	3,190
Discharges	0·34	0·49	0·75	1·11	2·07	2·98	5·83	12·01	22·45	51·97	100·00	2,181
Asthma Admissions	8·54	4·81	6·05	8·96	10·53	8·13	9·70	13·93	18·08	11·28	100·00	925
Discharges	5·70	3·83	5·35	8·01	8·10	10·22	10·66	14·72	16·95	16·45	100·00	543
Neoplasms (benign and unspecified)												
Admissions	11·63	6·37	7·94	8·59	8·86	10·71	10·06	11·91	11·82	12·10	100·00	2,887
Discharges	3·87	3·76	3·47	8·27	3·16	8·25	9·60	14·60	18·69	26·32	100·00	100
„ (malignant)												
*Admissions	1·88	2·72	3·41	4·44	5·67	7·63	10·01	13·16	23·19	27·88	100·00	104
Discharges	2·06	1·73	1·99	2·31	4·81	6·75	9·23	14·61	24·20	32·32	100·00	349
Hernia Admissions	12·37	7·63	7·39	8·42	9·46	11·02	12·32	12·15	11·03	8·22	100·00	6,868
*Discharges	0·39	0·31	0·47	1·24	1·67	2·91	5·31	10·04	14·56	63·10	100·00	367
D. **Psychiatric and Nervous disorders:**												
Sciatica Admissions	1·72	2·68	4·67	7·55	9·47	11·05	12·83	16·68	18·94	14·41	100·00	1,462
Discharges	1·41	1·90	2·32	3·42	5.95	7·96	12·44	20·36	18·91	25·31	100·00	413
Schizophrenia												
Admissions	21·18	15·39	9·85	9·48	9·48	10·34	8·13	8·13	5·42	2·59	100·00	728
Discharges	18·66	12·84	9·89	8·63	9·60	8·79	9·28	8·92	5·89	7·49	100·00	1,017
Paranoid state												
Admissions	0·44	1·33	1·43	3·95	7·36	6·02	11·65	21·63	17·58	28·59	100·00	68
*Discharges	0·21	1·16	1·25	4·72	4·19	5·66	11·18	14·23	31·94	25·45	100·00	140
Manic depressive psychosis												
Admissions	4·25	6·14	6·85	7·95	8·43	9·84	12·13	15·59	15·83	12·99	100·00	1,004
Discharges	3·24	3·83	4·68	6·33	7·61	9·83	12·27	17·44	16·91	17·86	100·00	992
Anxiety state												
Admissions	5·83	7·92	8·93	9·74	10·11	10·75	12·02	13·11	13·93	7·65	100·00	6,458
Discharges	2·91	3·54	4·57	5·71	7·11	9·09	11·04	16·00	19·33	20·70	100·00	6,325
Hysteria Admissions	15·03	10·05	8·68	9·42	10·79	9·52	10·16	9·21	10·79	6·35	100·00	2,908
Discharges	8·68	5·01	5·36	6·36	8·00	9·33	10·76	15·07	19·07	12·36	100·00	3,282
All psychiatric disorders												
Admissions	6·02	5·74	6·40	7·93	8·71	9·88	11·67	14·12	16·76	12·77	100·00	
Discharges	6·73	5·05	5·48	6·38	7·40	8·97	10·80	14·85	17·95	16·38	100·00	

* Sample includes 1944 cases.

Though discharge and hospitalization distributions for the peptic ulcers agree closely, striking discrepancies between the two distributions with respect to other diseases call for explanation. That the incidence of bronchitis among discharges increases more steeply with age than that of hospital cases is not surprising. Since the latter are far in excess of the former, we may infer that discharge with reference to chronic bronchitis includes only more serious cases among those represented by hospital admissions. The fact that it is a steadily progressive disease and the greater likelihood of emphysema among the oldest age groups might well suffice to account for the observed disparity; but greater reluctance to recommend for discharge younger soldiers may well contribute thereto. Since asthma depends on a congenital diathesis which may become manifest at an early age, it is not surprising that it exhibits no striking age-incidence trend among hospital admissions. That it shows increasing relative frequency with advancing age among medical discharges is possibly explicable in terms of administrative rather than of clinical considerations. As regards hernia we are on firmer ground. It is beyond dispute that the two sets of figures in Table IX refer to totally different categories. Whereas those for hospital admission refer exclusively to cases admitted for operation, mostly to *first* operations, those for medical discharges refer either to individuals who have not submitted to operative treatment or to recurrent cases. A similar discrepancy between hospital admission and discharge distributions with reference to benign neoplasms scarcely calls for explanation, since conditions so specified are very diverse with respect both to their nature and to their severity. The discharge data refer only to a small fraction of hospital cases, presumably the more grave.

With minor differences which are not surprising, age distributions of psychiatric disorders based on hospital admissions show the same features as those based on discharge from service. For United Kingdom hospital admissions with reference to schizophrenia the characteristic trend is more uniform than for medical discharges from the service. Since the number of United Kingdom cases hospitalized with respect to manic depressive psychosis exceeds discharges for the whole Army during the period covered, this diagnosis cannot of itself be a sufficient ground for discharge at the first diagnosis, and it is well known that its manifestations are liable to recur with increasing severity. Presumably these considerations account in large measure for a disparity between the two distributions cited in Table IX, i.e. (*a*) hospital admissions show a peak at about 44 years of age; (*b*) liability to discharge from service increases to the limit of the age range. A corresponding but more striking disparity emerges from comparison of the two sets of figures for anxiety state. The three conditions named, together with paranoid state, each have the facies of a clear-cut clinical phenomenon in so far as the age-incidence distribution discloses a uniform trend. The same is not true of obsessional psychoneurosis, of hysteria, of neurasthenia nor (needless to say) of so-called psychopathic personality.

Age-Incidence in the Female Population. With respect to most diseases A.T.S.

TABLE X

RELATIVE AGE-INCIDENCE DISTRIBUTIONS OF ADMISSIONS TO HOSPITAL IN THE U.K.; A.T.S. AUXILIARIES

	<22	22–24	25–27	28–30	31–33	34–36	37–39	>39	Total	Size of Sample	Q
A. Communicable Diseases:											
T.B. pulmonary (excl. pleurisy)	12·72	13·79	16·47	14·99	8·84	20·35	7·50	5·35	100·00	161	13·39
T.B. at other sites	15·69	16·74	13·12	9·65	5·73	9·80	29·26	—	100·00	94	15·08
T.B. all (excl. pleurisy) ..	13·79	14·76	15·32	13·23	7·80	16·71	14·90	3·48	100·00	255	13·93
Diphtheria ..	26·24	18·28	23·66	20·43	4·09	—	—	7·31	100·00	191	21·51
Dysentery—bacillary ..	20·87	22·01	7·97	17·08	6·07	10·44	15·56	—	100·00	111	18·98
*Chickenpox ..	29·56	7·61	16·81	15·75	7·79	7·08	—	15·40	100·00	155	17·70
*Glandular fever ..	26·89	6·39	19·67	12·13	15·74	19·18	—	—	100·00	106	16·39
Measles ..	24·52	6·29	16·13	6·45	15·16	3·23	14·52	13·71	100·00	304	16·13
Mumps ..	25·97	9·02	23·76	17·86	6·26	—	—	17·13	100·00	208	18·42
Rubella ..	33·95	7·25	16·56	6·42	11·18	14·49	—	10·14	100·00	264	20·70
Scarlet fever ..	28·41	10·36	13·05	16·89	9·98	8·64	12·67	—	100·00	275	19·19
Tonsillitis ..	29·38	10·66	16·70	21·13	9·46	6·84	3·42	2·41	100·00	534	20·12
Otitis media—acute ..	17·31	19·26	21·91	21·91	5·48	—	14·14	—	100·00	113	17·67
Sinusitis—all ..	16·98	6·59	9·63	14·32	21·04	14·58	5·45	11·41	100·00	214	12·67
Pneumonia—lobar	8·95	9·62	5·33	12·86	9·71	39·33	8·29	5·90	100·00	104	9·52
* „ —broncho	19·07	2·06	11·92	8·88	—	28·06	—	30·01	100·00	96	10·83
Infective hepatitis	16·44	14·65	12·71	11·96	12·41	15·25	13·45	3·14	100·00	302	14·95
Syphilis—primary, early and secondary ..	19·69	11·08	12·77	9·38	16·77	—	—	30·31	100·00	98	15·38
Gonorrhoea—primary ..	16·18	13·15	11·27	12·72	21·10	13·58	—	11·99	100·00	390	14·45
Scabies ..	33·41	16·59	11·29	10·14	8·99	10·14	7·60	1·84	100·00	829	23·04
Impetigo ..	33·67	19·39	14·54	10·97	2·81	4·59	14·03	—	100·00	328	25·51
C. Other Organic Disorders:											
Appendicitis ..	22·02	16·33	17·25	13·94	7·89	8·62	10·09	3·85	100·00	1,821	18·35
Bronchitis—chronic ..	3·65	5·45	7·30	8·41	7·42	19·25	4·75	43·77	100·00	111	5·80
Asthma ..	15·55	5·74	14·95	12·80	14·47	7·18	10·53	18·78	100·00	206	11·96
Neoplasms (benign and unspecified)	7·15	3·86	9·40	7·78	11·78	17·67	18·30	24·05	100·00	488	7·01
D. Psychiatric and Nervous Disorders:											
Schizophrenia ..	7·61	5·26	13·20	11·42	14·41	19·84	7·37	20·89	100·00	100	8·10
Psychopathic personality ..	9·48	5·95	12·73	15·15	14·87	25·65	—	16·17	100·00	111	9·29
Manic depressive psychosis ..	6·60	7·73	7·41	14·65	16·18	13·93	24·80	8·70	100·00	177	8·05
Anxiety state ..	5·66	7·02	9·96	12·30	14·94	18·26	12·68	19·17	100·00	432	7·55
Hysteria ..	16·00	10·67	9·87	15·07	8·53	20·27	13·73	5·87	100·00	444	13·33

* Sample includes 1944 cases.

hospital admissions for a single year (Table X) are relatively few, and, since the age composition of the population at risk is very skew, the computed relative incidence of the older age groups is liable to considerable variation. With due regard to these considerations, previous remarks with reference to communicable diseases (and to appendicitis) apply equally to males and to females. There is one apparent exception to this statement, namely infective hepatitis. Among women the incidence of this disease does not appear to fall off conspicuously with age. This may be partly due to the fact that it is much less common among women than among men, though

TABLE XI

MALE STANDARDIZING FACTORS WITH RESPECT TO U.K. HOSPITAL ADMISSIONS

(*A.T.S. as standard population*)

	1943	1944
Scarlet fever	1·569	1·409
T.B. pulmonary	0·984	0·957
T.B. at other sites	1·235	1·178
Infective hepatitis	1·223	1·243
Impetigo	1·496	1·437
Tonsillitis	1·166	1·130
Pneumonia	1·204	1·097
Chronic bronchitis	0·544	0·509
Otitis media	1·135	1·128
Gonorrhoea	0·994	1·066
Syphilis	0·957	0·992
Hernia	1·044	0·982
Appendicitis	1·343	1·305
Asthma	0·880	0·814
Peptic ulcer—all	0·531	0·528
Gastric ulcer	0·475	0·468
Duodenal ulcer	0·540	0·540
Nephritis	0·957	0·937
All psychiatric disorders ..	0·800	0·772
All other diseases	1·032	1·000
All diseases	1·042	1·012

conceivably also to a sex-difference with respect to the power of the body to react to the virus antigen. Male and female distributions of scabies, each referable to large samples, reveal a striking difference which may well be spurious. A high proportion of patients do not receive hospital treatment, and the male sample almost certainly contains a higher proportion of intractable cases, which inflate incidence in the older segment of the population. The only psychiatric disorders for which A.T.S. samples are large enough to justify confidence exhibit no features other than those which the discharge data disclose. One feature worthy of comment in Table X is a dip in the 22–24 age group of virus diseases, scarlet fever and tonsillitis.

A similar dip is evident in the figures of Table VIII, where it might otherwise provoke the suspicion that our estimate of the relative strength of this age group in the 1943 United Kingdom Army population is somewhat excessive.

Sex Differentials. The data in Table VIII provide a basis for standardization of figures referable to populations of different age composition. If our aim is to assess sex differences with respect to morbidity, it comes to the same thing to ask either (*a*) what the female rate would be if, with its own age-incidence distribution, the age-strength distribution were that of the male population in the same year or (*b*) what the male rate would be if, with its own age-incidence distribution, its age-strength distribution were that of the female population in the same year. Since we have larger samples for the male population, the second is preferable.

TABLE XII

RELATIVE STRENGTH-AGE DISTRIBUTIONS

	<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total
Known whole Army 1943–1944 ..	14·04	17·92	16·66	15·79	13·52	9·48	6·67	3·98	1·12	0·82	100·00
Estimated U.K. 1943–1944 ..	15·79	15·87	15·19	14·81	13·40	9·93	7·49	4·82	1·49	1·20	100·00
Known C.M.F. mid-Feb. 1945 ..	7·66	19·20	19·96	17·08	14·27	10·50	6·94	3·07	1·07	0·25	100·00
Known M.E.F. mid-Feb. 1945 ..	4·66	15·66	21·33	19·82	14·78	11·01	7·23	3·60	1·49	0·42	100·00
Estimated M.E.F. 1943–1944 ..	5·00	21·50	20·00	17·00	14·00	10·50	7·00	3·40	1·10	0·50	100·00

Table XI shows some standardizing factors computed on this basis. To say that the military (male) standardizing factor with reference to A.T.S. strength for gastric ulcer in the year 1944 is 0·468 means that it is necessary to multiply the male incidence in that year by 0·468 to make it comparable with the female incidence of the same year, with the implication that differences with reference to age composition of the two populations do not then affect conclusions drawn from such a comparison.

The sex difference already noted with respect to the incidence of peptic ulcers merits further comment in this context. In the female population the total annual number of peptic ulcers specified as such is small. In 1943 there were 50 hospital admissions and 61 discharges from the service. The ratio of duodenal to gastric ulcers based on the breakdown of these figures is very much smaller than the corresponding ratio for males. Though the female sample is small, the difference is worth recording, because the effect of age standardization is to reinforce the impression derived from the crude figures.

RATIOS OF DUODENAL TO GASTRIC ULCERS

	Males	*Females*
Discharges		
Crude	4·7	2·5
Standardized	5·4	2·5
Hospital admissions		
Crude	3·9	1·9
Standardized	4·4	1·9

These figures suggest the conclusion that the excessive incidence of peptic ulcers in the male Army population is largely due to greater liability of the male to the duodenal type, which is the more common of the two. Without more data, this must remain a suggestion. It would be interesting to know how relative liability to one or other type is related to occupation.

TABLE XIII

		<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Sample size
Duodenal ulcer	A	1·45	1·74	3·29	4·09	4·89	7·13	9·48	12·52	18·93	36·47	100·00	453
	B	2·76	1·93	4·08	5·09	6·18	8·84	11·65	14·02	22·83	22·61	100·00	453
	C	2·21	3·33	4·59	7·35	8·78	10·96	13·21	16·76	17·49	15·30	100·00	4,665
Gastric ulcer	A	1·32	1·93	2·70	2·56	4·25	7·70	9·22	13·17	3·16	53·98	100·00	121
	B	2·80	2·39	3·73	3·57	6·01	10·67	12·67	16·49	4·27	37·40	100·00	121
	C	1·51	1·98	2·71	4·34	5·90	9·75	12·61	16·71	19·38	25·12	100·00	995

6. RELATION OF AGE TO HOSPITAL ADMISSIONS IN THE MIDDLE EAST

The preceding section has emphasized a striking dichotomy with respect to the risk of specific diseases at different ages. With a few exceptions seemingly consistent with such an explanation, diminishing frequency of communicable diseases as age increases is interpretable on the assumption that immunization by previous attack progressively reduces the effective, as opposed to the apparent, population at risk. Such a progressive reduction will not occur if previous attacks confer little immunity and it will not be relevant to the age-risk relation if the disease is: (*a*) extremely rare; (*b*) highly fatal; (*c*) absent in the original habitat of a newly immigrant population. The first two limitations have been the subject of earlier comment. Morbidity experience of an Army population serving overseas offers an opportunity of testing the general hypothesis stated above by reference to the third (*c*), as an independent check.

Hospital admission records of troops serving in the Middle East during 1943–4 furnish large samples for this purpose; but analysis of such records again confronts us with the difficulty of assessing the exact population at risk in different age groups, because our first available information for the exact age composition of an overseas

force refers to the beginning of 1945. At that time conditions in the Middle East were very different from such as existed in 1943, when fighting was in progress. We have therefore made an estimate of the age composition of the M.E.F. in 1943–4 by the method of adjusting the figures for the Army as a whole in such a way as to bring the age-incidence distribution of certain marker diseases into close correspondence with the known distribution of these diseases among medical discharges. This adjusted distribution, referred to as *estimated* M.E.F. 1943–1944 at the foot of Table XII, and hereinafter used as a basis for the age-incidence distributions indicated as *B*, tallies more closely with the known early 1945 age composition of the Central Mediterranean Force than with that of M.E.F. at the same date. This is not remarkable, since large numbers of Middle East troops were transferred to C.M.F. at the end of the Middle East campaign. We shall

TABLE XIV

		<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Sample Size
Infective hepatitis	A	14·63	18·59	13·99	10·71	8·06	6·97	5·52	5·12	5·08	11·34	100·00	6,256
	B	22·49	16·67	14·02	10·79	8·24	7·00	5·49	4·64	4·96	5·69	100·00	6,256
	D	16·28	15·07	13·12	12·39	10·09	8·26	7·65	6·08	5·83	5·22	100·00	3,536
Appendicitis	A	15·06	14·83	11·57	9·58	8·28	6·62	7·20	5·25	8·03	13·58	100·00	1,847
	B	23·30	13·38	11·66	9·72	8·52	6·68	7·21	4·79	7·88	6·85	100·00	1,847
	D	21·42	13·34	10·53	10·89	10·04	8·20	8·69	7·34	5·26	4·20	100·00	4,874

later refer to age incidence distributions, based upon the C.M.F. 1945 age composition, as estimate A, and cite in Table XV age-incidence distributions with reference both to the actual age composition of C.M.F. in 1945 (A) and to the age composition of M.E.F. in 1943–1944 (B) computed in conformity with appropriate marker statistics.

As a background to the order of error arising from this uncertainty, Table XII shows relative sizes of the populations at risk in different age groups.

For comparison with the marker statistic (C) based on discharge figures shown in section 4 above, the following table (XIII) shows distributions of peptic ulcer based on different estimates of the M.E.F. strength: A, the known C.M.F. distribution at mid-February 1945; B, the corresponding adjusted distribution referred to in the previous table as " Estimated M.E.F. 1943–1944."

Since United Kingdom strength distributions used in the preceding section yield results in close agreement with those based on comparable discharge figures, we may also cite (Table XIV) United Kingdom distributions (D) of two other diseases as a check on the credentials of B and A. Again B tallies more closely with the marker statistic.

While it is clear that the use of estimate B gives results which more nearly correspond with the marker statistics cited, the following table (XV) gives

distributions for diseases in M.E.F. on both estimates (A and B) of the population at risk in the several age groups.

To assess the propriety of any estimate we employ, it is necessary to give due consideration to the following issues. In view of circumstances relevant to selection of the youngest and oldest for service overseas at different stages of the

TABLE XV

RELATIVE AGE INCIDENCE DISTRIBUTIONS; MIDDLE EAST, 1943–44

		<22	22–24	25–27	28–30	31–33	34–36	37–39	40–42	43–45	>45	Total	Sample Size	Q
Malaria B.T.	A	9·52	13·36	11·46	11·07	9·42	8·61	7·68	8·89	5·96	14·03	100·00	13,443	10·63
	B	15·23	12·47	11·94	11·61	10·03	8·99	7·96	8·39	6·05	7·33	100·00	13,443	11·10
Malaria M.T.	A	8·61	14·68	11·27	9·26	8·88	8·49	8·42	9·03	6·33	15·02	100·00	1,392	10·43
	B	13·95	13·86	11·89	9·84	9·57	8·98	8·83	8·63	6·52	7·94	100·00	1,392	11·03
Dysentery Flexner	A	16·78	11·31	8·96	9·83	8·70	8·17	8·16	8·91	11·98	7·21	100·00	549	10·02
	B	25·09	9·78	8·66	9·57	8·59	7·91	7·83	7·79	11·29	3·49	100·00	549	9·70
Amoebic dysentery	A	5·83	9·91	10·60	9·88	10·30	8·52	8·47	11·03	10·13	15·34	100·00	1,501	9·59
	B	9·59	9·50	11·35	10·65	11·26	9·15	9·02	10·68	10·57	8·23	100·00	1,501	10·29
Typhoid	A	12·79	14·29	12·28	12·63	10·64	8·41	13·42	6·39	9·16	—	100·00	244	11·96
	B	18·76	12·20	11·72	12·14	10·37	8·04	12·73	5·51	8·52	—	100·00	244	11·44
Sandfly fever	A	11·47	15·98	12·25	11·37	10·29	8·03	8·53	8·53	6·60	6·95	100·00	8,527	11·59
	B	17·55	14·26	12·21	11·42	10·48	8·02	8·45	7·70	6·43	3·47	100·00	8,527	11·58
Leishmaniasis cutaneous	A	11·59	18·78	13·61	14·38	11·71	9·95	9·79	10·19	—	—	100·00	256	13·37
	B	17·18	16·21	13·15	13·98	11·56	9·63	9·39	8·90	—	—	100·00	256	12·94
Keratitis	A	8·01	10·26	9·09	10·40	9·50	9·26	9·77	9·99	8·35	15·38	100·00	752	9·61
	B	12·99	9·70	9·61	11·07	10·25	9·81	10·25	9·55	8·60	8·15	100·00	752	10·18
Conjunctivitis	A	8·62	10·44	8·79	7·58	8·24	9·05	8·82	10·22	8·99	19·25	100·00	1,107	8·91
	B	14·25	10·05	9·47	8·22	9·06	9·76	9·43	9·95	9·44	10·38	100·00	1,107	9·61
Cystitis and pyelitis	A	5·59	10·45	9·39	10·21	9·68	7·67	12·32	13·94	7·65	13·11	100·00	586	9·64
	B	9·12	9·94	9·99	10·93	10·51	8·17	13·01	13·41	7·94	6·98	100·00	586	10·27

war, any *estimate* of basic strength data is specially liable to error in the two age groups at the extremes of the range, viz. *under* 22 and *over* 45. Consequently, it would be foolish to attach any signal importance to features characteristic of the limiting fringes of the distribution. With respect to any legitimate conclusions we may base on such estimates, it is also necessary to take stock of other circumstances:

(*a*) infantry, being more exposed to conditions where preventive measures are least effective, is the arm of the service with a concentration of the younger age groups;

(*b*) the youngest age group is presumptively the group with the shortest mean period of overseas service, and hence the one least liable to previous exposure to risk;

(*c*) the over 45 age group is likely to have:

(i) a relatively high concentration in static units where risk of disease is at a minimum;

(ii) an abnormally high proportion of regular soldiers who have been previously exposed to infections not prevalent in the United Kingdom;

(iii) a make-up resulting from especially vigorous selection with reference to physique or general health.

For all these reasons we should discount: (*a*) any *minor* trends with respect to susceptibility as age increases; (*b*) any conclusions referable to the oldest or youngest age group. Figures for the oldest age group in Table XVI refer in all cases to a very small sub-sample, and are hence liable to gross sampling error as well as to errors arising from circumstances stated above. With one possible exception, i.e. *Flexner's dysentery*, it is noteworthy that no disease included in this table displays a conspicuously steep trend comparable with what is so characteristic of communicable diseases in the United Kingdom. Though we have no means of assessing precisely the incidence of the *Flexner* type in the United Kingdom, clinical experience suggests that it is not uncommon in institutions; and its occurrence in the civilian population may well be more extensive than one commonly supposes. In any case, there are good grounds for believing that it is less rare than typhoid. These distributions are admittedly imperfect for a variety of reasons stressed above. With due recognition of their imperfections the conclusion to which we are led is consistent with the hypothesis previously advanced to account for declining incidence of communicable diseases as age advances. It is unfortunate that available statistics with reference to Colonial troops do not include basic demographic data to elucidate the complementary issue, i.e. whether a population exposed to risk in early youth would present a totally different picture.

7. Significance of Age in Relation to Immunity

We have seen that: (*a*) age-specific rates for non-communicable diseases usually go up as age advances; (*b*) age-specific rates for communicable diseases usually go down. We have also discussed certain exceptions to these rules *vis à vis* reduction of the effective population at risk by immunization. It is not unprofitable to scrutinize the quantitative implications of this hypothesis in greater detail. In conformity with symbols used elsewhere, we suppose that there are C_x cases of a disease in a population containing P_x individuals of the same (xth) age group, so that the incidence in the xth age group is $I_x = C_x \div P_x$. We also specify the corresponding *effective* (non-immune) population at risk as S_x, being less than P_x; and the *effective incidence* which measures the true liability of an x-year-old to contract

the disease as $E_x = C_x \div S_x$. The size of the population in successive age groups is irrelevant to our purpose. We can therefore restrict our population to a *standard* one of age groups of equal size, putting $P_x = P_{x+1}$, etc.

The simplest form our hypothesis may take is that the true liability E_x to contract a *non-fatal* disease is not affected by age, i.e. diminishing incidence as age advances is wholly attributable to immunization. Accordingly $E_{x+1} = k = E_x$. We may first assume that immunization to a single attack is complete, so that:

$$\begin{aligned} S_{x+1} &= S_x - C_x \\ \therefore\ C_{x+1} &= E_{x+1}\ (S_x - C_x) \\ &= E_x(S_x - C_x) \\ &= E_x\, S_x - E_x\, C_x \\ &= C_x - E_x\, C_x \\ \therefore\ \triangle C_x &= -E_x\, C_x \\ &= -kC_x \end{aligned}$$

Since $I_x = C_x \div P_x$ and $I_{x+1} = C_{x+1} \div P_x$:

$$\triangle I_x = -kI_x$$

This is the difference equation of a geometric series of which the general formula is:

$$I_x = I_o\,(1-k)^x \qquad \text{(i)}$$

Within the framework of our first set of assumptions, the hypothesis stated therefore implies an exponential law of declining incidence. Within the army age group this accords with the picture disclosed by our data (Table VIII) of such diseases as : *Chicken pox*, *Measles*, *Rubella*, *Diphtheria*, *Mumps*, *Scarlet fever*, *Impetigo*, *Glandular fever*, *Infective hepatitis*.

If immunization is *incomplete*, *i.e.* if a previous infection fails to protect a *certain proportion of individuals* from a subsequent manifest attack, the only necessary qualification to the preceding argument is that previous attack removes a fraction m (<1) of cases from the effective population at risk in the xth year of life, so that:

$$\begin{aligned} S_{x+1} &= S_x - m.\ C_x \\ \therefore\ \triangle I_x &= -m.k.I_x \end{aligned}$$

If we put $K = m.k$

$$I_x = I_o\,(1-K)^x \qquad \text{(ii)}$$

Since $m < 1$, $K < k$ and the only effect of the change of constant is to make the graph of I_x in (ii) less steep than that of I_x in (i).

The preceding treatment postulates that the disease is *not* fatal. If it is more or less fatal, we have to introduce a *survival* rate formally analogous to m also <1, and the effect of doing so is merely to reduce the rate of declining incidence. Clearly its slope would be zero if the survival rate were zero.

Within the compass of the foregoing assumptions, we can provide for more or less steep decline of incidence which we can represent by an exponential function with a line parallel to the x-axis as the limiting case; but we cannot account for a secondary nor for an initial rise without recourse to other postulates. It is reasonable to assume that what we have here called the true liability E_x is *not*

constant, increasing with age as it does for most diseases which are not communicable. The functional relation we chose is necessarily arbitrary, but for various reasons we can take as sufficiently generalized:

$$E_x = E_o\, a^x \textit{ and } E_{x+1} = aE_x$$

The new hypothesis implies that the constant a in the above is *greater* than unity. As before we put:

$$C_{x+1} = E_{x+1}(S_x - C_x)$$
$$= (a - E_o a^{x+1})C_x$$
$$\therefore\ I_{x+1} = (a - E_o a^{x+1})I_x \qquad \text{(iii)}$$
$$\therefore\ \triangle I_x = (a - 1 - E_o a^{x+1})\, I_x \qquad \text{(iv)}$$

A solution of the above is:

$$I_x = I_o \cdot \prod_{r=1}^{r=x} (a - E_o a^r) \qquad \text{(v)}$$

From the form of (iii) it is evident that I_x *increases* as x *increases* when $(a - E_o a^{x+1})$ is *greater* than unity, diminishes when $(a - E_o a^{x+1})$ is less than unity, and undergoes no change when

$$a - E_o a^{x+1} = 1 \qquad \therefore$$
$$x = \log_a \frac{a-1}{aE_o} \qquad \text{(vi)}$$

By hypothesis, $a > 1 > E_o$ and both constants are positive. With these limitations the factor $(a - E_o a^{x+1})$ must decrease as x increases; but it may exceed unity at the start. In other words I_x may initially increase to a maximum defined by (vi) and subsequently diminish. It *cannot* at first decrease and subsequently increase. Within the framework of approximations inherent in the derivation of the preceding difference equations, the hypothesis that the trend of incidence is the outcome of interplay between immunization and increasing liability is thus consistent with the possibility of an initial rise followed by a fall, as is true of *phthisis* in the Army age range, but would not appear to allow for an initial decline with a subsequent rise. If immunity is incomplete in the sense defined above or if the disease is partially fatal, we have to introduce a factor m as before. The corresponding difference equation is:

$$I_x = a^x\, I_o \prod_{r=o}^{r=x-1} (1 - m\, E_o\, a^r)$$

The maximum value is then given by:

$$x = \log_a \frac{a-1}{am\, E_o}$$

As before, $a > 1$, E_o and m both < 1. The preceding remarks therefore hold good.

We have not, however, examined the consequences of imposing the limitation that immunity is *temporary*, persisting over a period of n age-units. If we postulate a fixed liability k as in (i) above and proceed as before, we arrive at the difference equation:

$$I_{x+1} = (1 - k)\, I_x + k.\, I_{x-n}$$

This reduces to a simple algebraic formula for the general term, when $n = 1$, i.e. immunity persisting for 1 year if we reckon age (x) by years; but it is simple to

build up the corresponding series by assuming particular values of k or n when $n>1$. In any case, we can choose our age unit to tally with the period of immunity conferred if the latter is relatively short in terms of the whole span of life. The above then reduces to a linear difference equation of the second order, *i.e.* to the form:

$$I_{x+2}+(k-1)\,I_{x+1}-kI_x=0$$

The standard solution of this defines a *recurrent* series being:

$$(1+k)I_x=(k\,I_o+I_1)+(I_o-I_1)\,.\,(-k)^x$$

Values of I_x decrease as x increases with a highly damped periodicity approaching a positive limit. Since $k=I_o$ by definition, the limit is given by:

$$I_x=(I_o^2+I_1)\div(1+I_o)$$

By introducing the postulate of *temporary* immunity, we thus arrive at the difference equation of a function whose numerical properties are consistent with an initial fall and subsequent rise as is characteristic of *lobar pneumonia* in the Army age range. A comprehensive and more exact analysis of the issue therefore offers the hope of defining a precise statistical criterion to assess the validity of the assumption that a single attack of a disease confers *permanent* immunity.

Conclusion

The foregoing exposition has brought into focus two main issues. One is a dichotomy between two categories of disease which we may respectively distinguish as communicable and progressive. The significance of this broad distinction with respect to the relation of age to disease risk has been the subject of detailed treatment in section 7; and there is no need to traverse a second time the issues there discussed, nor to restate the provisional hypothesis advanced. Another facet of the relation between age and morbidity risk directs our attention to what medical problems in one or other age group of the population have more or less priority *vis à vis* allocation of specialist man-power and the claims of research within the framework of a National Health Service. That the urgent medical problems of the youngest and oldest age groups in the population are peculiar is a commonplace; but the extent to which the occurrence of particular diseases depends on the age composition of a community has hitherto received little attention. It is one which clearly deserves closer scrutiny against the background of researches, such as those of Enid Charles and others, whose work has emphasized the prospect of a very considerable shift in the age composition of our own population. Such a shift calls for a readjustment of our views concerning the relative magnitude of different diseases as matters of concern to the community as a whole. At present, the social machinery of medicine outside the armed Services does not permit a direct attack upon this problem *en rapport* with that of the present inquiry; but it should be possible to follow up clues suggested by morbidity experience within the Army age group by recourse to field inquiries employing sampling methods.

We wish to acknowledge helpful suggestions from Dr. A. P. Thomson, Dr. Enid Charles and Lt.-Col. James who read the proofs of this paper.

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DIETARIES IN MATERNITY HOSPITALS

BY

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Several comprehensive studies of hospital feeding have been planned to show as precisely as possible the nutritive value of representative diets provided in hospitals for patients and staff. The Scientific Advisory Committee of the Department of Health for Scotland has been carefully examining the problem of hospital diets and has made surveys and will publish a report in due course.

The purpose of this survey, which was carried out under the aegis of the Sub-Committee on Nutrition of the Department of Health for Scotland, was to determine the nutritive value of diets provided to nursing mothers while in hospital. Fifteen hospitals were visited during the period February to August 1945; 8 were voluntary hospitals, and, of these, 2 were solely maternity hospitals; 5 were local authority hospitals, and, of these, 4 formed parts of general hospitals; and 2 were E.M.S. hospitals, both of these dealing only with maternity cases. Except for the north-west area of Scotland, the hospitals, urban and rural, were representative of the maternity hospital service in Scotland. The kitchens were of various sizes, the smallest catering for some 60 persons (staff and patients), the largest for 2,000. The results of the surveys show that there was no correlation between the dietary standard and the type of hospital, its size and location or the season of the year when the survey was made.

METHODS

Surveys were carried out throughout one week in each hospital. The ward containing the greatest number of beds was chosen, and when practicable more than one ward was included. Usually the wards contained both antenatal and postnatal patients but little differentiation, in most cases none at all, was found between the feeding of these two groups. All aspects of the catering service were observed, and particularly those concerning the condition of the food as it reached the patients.

Hospital meals

During the survey an extra diet was ordered each day for the ward concerned, and at every meal time a sample serving of each dish provided was chosen and the contents weighed. Bread, milk, tea, etc., were averaged daily on the individual

intake of six or more patients at separate meals: general and plate wastage was observed. Calculations of carbohydrate, protein, animal protein, and fat in each day's diet were made: an estimation of mineral salts and vitamins was made from a daily average of the total intake of the various foods contained in the week's diet as a whole. Extras were checked by a detailed examination of a chosen number of patients in each ward.

" Extras "

Six patients were chosen: in each case, a record of the weight of foodstuffs already in the possession of individual patients was kept, and all additions that were made throughout the week. The amount of food wasted, given away, or otherwise disposed of, and also the amount which remained, were deducted at the end of the week and a daily average intake was calculated in each case. Finally, an average of the " extras " consumed by the six patients was taken.

The basis of calculations

The calculations of the various nutrients were made from the Medical Research Council's *Nutritive Values of War-time Foods* (War Memo. No. 14, 1944), and from *The Chemical Composition of Foods* (McCance and Widdowson, 1940). Vitamin C values are in every case the result of analyses by one of us (C.P.S.) of foods taken at the time of serving. Made up foods, and unknown and doubtful articles of diet, such as sausages, were analysed chemically, and the food values of soups, sauces, etc., were calculated from the actual quantities of the ingredients used in their preparation in the hospital kitchen.

Standards of comparison

In determining the adequacy of a diet the nutrient requirements of the community or group under examination must be estimated. In all dietary surveys the difficulty of determining a standard of comparison is ever present. Numerous dietary standards of required nutrients have been published, e.g. that suggested by the National Research Council, U.S.A. (1941), but this does not necessarily give the minimal amount compatible with health. Indeed it is now generally accepted that, as far as this country is concerned, the National Research Council requirements are in most cases well above the optimum for health. It should also be borne in mind that these requirements are for nursing mothers who are not confined to bed, that they are supplied by food as purchased, that, in following them, allowance has been made for losses in storage and preparation as well as in absorption and utilization of the foodstuff.

To arrive at a standard of comparison, a diet was devised which was regarded as possible within the existing conditions of food rationing and supply, and which would generally be accepted as good. The composition of the diet in terms of nutrients was calculated, and thus a reasonable target was adopted, the attainment of which was certainly possible for every maternity hospital. It should, however, be emphasized that the target represents *the food consumed* by the subject, that allowance has been made only for unavoidable losses, and that the attainment of

such a target from the foods suggested demands a higher standard of preparation and cooking than that which generally obtains. The suggested diet is shown in Table I. The calculated average daily consumption of nutrients from the suggested

TABLE I

SUGGESTED MATERNITY DIET.—CALCULATIONS BASED ON THE M.R.C. "NUTRITIVE VALUE OF WAR-TIME FOODS"

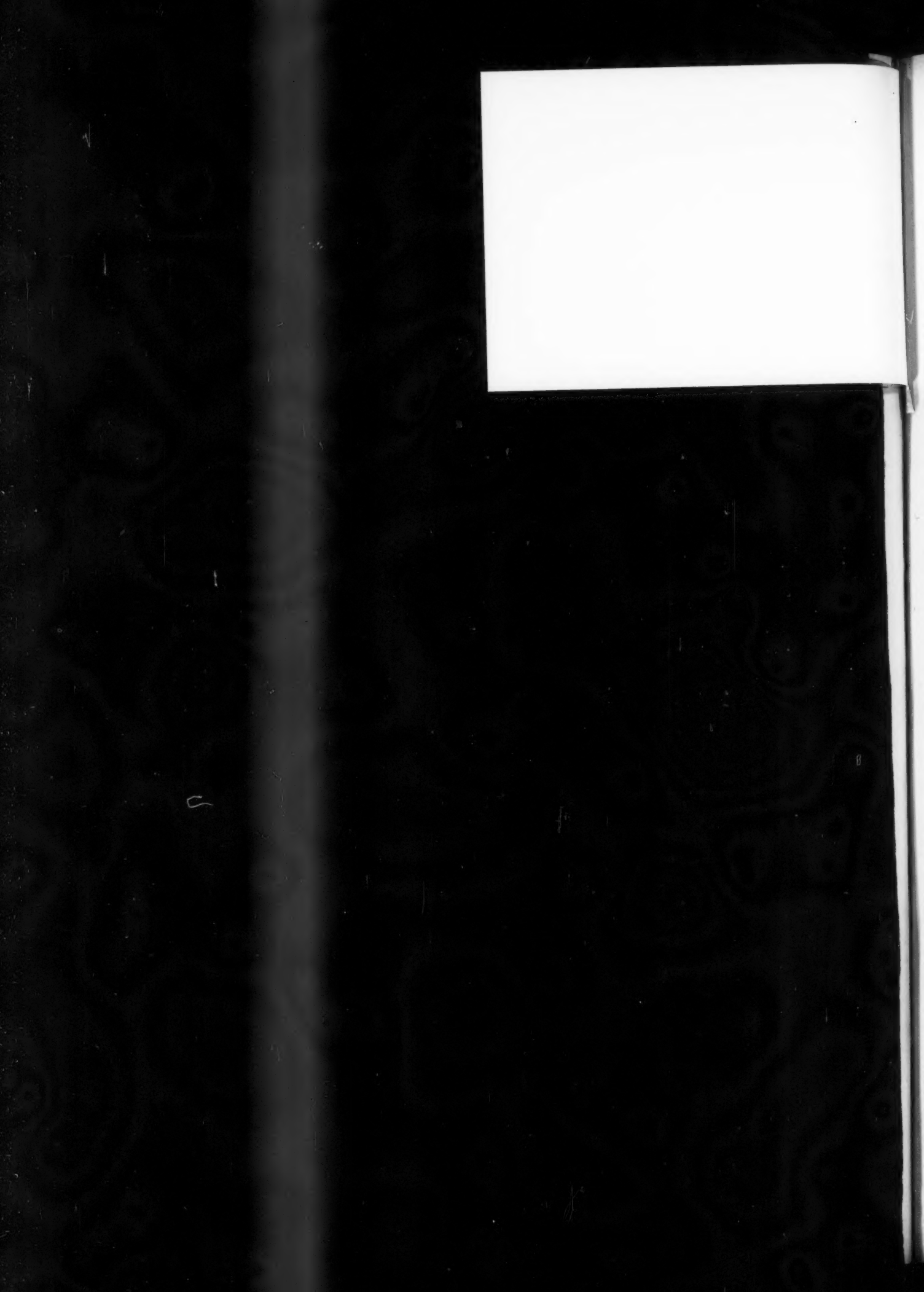
	Average g. per day	Calories	Protein	Fat	Cho.	Ca. Mg.	Fe. Mg.	Vitamin A I.U.	Thiamin µg.	Riboflavin µg.	Nicotinic acid mg.	Vitamin C mg.
Milk	1,150	723	37·0	41·4	50·6	1,380·0	1·15	805	518	1,725	24·0	7
Margarine ..	17	131	—	14·5	—	0·7	·05	340	—	—	—	—
Butter	8	60	—	6·6	—	1·2	·01	320	—	—	—	—
Cocoa	6	26	1·2	1·5	1·9	3·1	·86	3	7	—	—	—
Sugar	32	115	—	—	30·4	0·3	—	—	—	—	—	—
Egg, fresh 15g. / dried 10g.	25	35	2·8	2·5	0·2	15·0	·75	220	38	88	·10	—
Bacon	10	45	0·8	4·7	—	0·9	·09	—	41	20	·11	—
Meat (rationed) ..	30	60	4·8	4·5	—	3·0	1·10	14	23	60	·36	—
Bread, buns, etc., 150 / 50	200	498	17·2	2·0	102·8	108·0	2·40	—	257	105	·68	—
Cabbage, greens ..	50	13	0·8	—	2·5	33·0	·50	150	38	25	·02	9
Semolina, etc. ..	12	41	1·3	0·2	8·3	2·2	·12	—	11	8	·04	—
Flour	20	69	2·4	0·3	14·2	16·4	·32	—	49	40	·09	—
Potato	160	117	3·2	—	25·9	12·8	1·10	—	192	80	·32	16
Carrots	20	4	0·1	—	1·0	9·6	·12	1,333	12	10	·04	1
Turnips	15	3	0·1	—	0·5	8·9	·06	—	5	8	·03	2
Cheese	8	29	1·8	2·5	—	58·0	·05	104	2	40	—	—
Jam	16	40	—	—	9·9	1·9	—	1	—	—	—	1
Oatmeal	28	109	3·3	2·4	18·3	15·4	1·14	—	126	8	·08	—
Cooking fat ..	13	116	0·1	12·9	—	—	·01	—	—	—	—	—
Beans, peas ..	20	58	4·4	—	10·2	6·6	1·08	13	90	60	·02	—
Fish (fatty) ..	20	27	3·2	1·6	—	20·0	·30	30	2	30	·16	—
Fish (white) ..	20	14	3·2	0·1	—	5·0	·20	—	12	30	·10	—
Raisins	4	8	—	—	2·3	2·4	·06	1	—	1	·01	—
Prunes	8	11	0·2	—	2·6	2·7	·12	66	—	2	·16	—
Barley	4	13	0·3	0·1	2·9	0·4	·03	—	3	3	·01	—
Macaroni	6	20	0·6	0·1	4·2	1·6	·08	—	5	—	·02	—
Spam	9	23	1·4	1·9	—	0·9	·18	—	40	3	·06	—
Bridie	14	51	1·5	3·2	3·9	2·1	·28	—	14	2	·07	—
Black pudding ..	9	23	0·9	1·6	1·2	2·7	·09	—	15	6	·05	—
Sausage	9	23	0·9	1·6	1·2	2·7	·09	—	15	6	·05	—
Tripe (or other offal)	16	13	2·4	0·7	—	1·2	·28	—	4	12	·13	—
Rabbit	16	13	2·4	0·7	—	1·2	·28	—	4	12	·13	—
Baked beans ..	14	12	0·8	—	2·2	7·7	·35	23	8	5	·03	—
Stewed apple ..	12	2	—	—	0·5	0·2	·01	6	5	—	—	—
Onion	6	1	—	—	0·3	1·6	·02	—	1	—	—	—
Totals ..		2,546	99·1	107·6	298·0	1,729·4	13·28	3,429	1,537	2,389	27	36

NOTES

Bread: taken as 150 g. bread plus 50 g. buns calculated as bread except for thiamin and riboflavin, which are taken as 50% of the bread figure.
Milk: Vitamin A—winter figure used.
Butter: calculated at 2,000 I.U. Vitamin A per 100 g.
Thiamin: 15% of total allowed for cooking losses, etc.
Vitamin C: cooking losses taken as 75% for green vegetables and 50% for other vegetables.
Thiamin: 1,537 µg. less 15%—1,306 µg.=1·3 mg.

CORRECTION

An error occurred in Table I of an article by E. W. H. Cruickshank and C. P. Stewart on Dietaries in Maternity Hospitals published in the *British Journal of Social Medicine* for July 1947, Vol. 1, No. 3, p. 183. The figure for nicotinic acid in milk was given as 24·0 mg. This should have read 1·2 mg., which is the amount of nicotinic acid in 1,150 g. (two pints) of fresh milk. The figures were based on old analyses, and since recent analyses show the content of nicotinic acid of foodstuffs to be much lower, the whole of the nicotinic acid column should be ignored.



MENU FOR WEEK

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
BREAKFAST Porridge and Milk Bacon Fried bread Bread and margarine Tea	Porridge and Milk Herring Marmalade Bread and margarine Tea	Porridge and Milk Omelette (dried egg) Bread and margarine Tea	Porridge and Milk Bacon Bread and margarine Tea	Porridge and Milk Sausage Bread and margarine Tea	Porridge and Milk Black pudding Marmalade Bread and margarine Tea	Porridge and Milk Egg, boiled, etc. Bread and margarine Tea
MID-MORNING Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit	Milk or milk shake Bun or biscuit
DINNER Vegetable broth Stewed rabbit Carrot, turnip Onion Beans/peas Potato Semolina Stewed apple Milk	Split pea soup Spam Green salad, etc., or cooked greens Potato Steamed jam or syrup pudding Custard Milk	Potato soup Mince Cabbage Potato Semolina/prunes Milk	Brown vegetable soup Macaroni cheese Cauliflower Potato Chocolate cornflour pudding Milk	Bean/pea soup White fish Parsley sauce Potato Steamed fruit pudding Custard Milk	Vegetable broth Steak pie Brussels sprouts Potato Custard pudding Milk	Barley soup Roast beef or mutton Cabbage Potato Semolina Raisin pudding Milk
TEA Bread and butter Scone or bun Jam Tea	Bread and butter Scone or bun Madeira cake Tea	Bread and butter Scone or bun Jam Tea	Bread and butter Scone or bun Sponge cake Tea	Bread and butter Scone or bun Jam Tea	Bread and butter Scone or bun Fruit cake Tea	Bread and butter Scone or bun Gingerbread Tea
SUPPER Shepherd's pie Bread and margarine Milk/cocoa	Tripe (or offal) Bread and margarine Coffee blancmange	Bridie Baked potatoes or chips Bread and margarine Milk/cocoa	Baked beans Roast potatoes Bread and margarine Milk	Egg (fresh) Bread and margarine Raspberry blancmange	Welsh rarebit Bread and margarine Milk/cocoa	Sardines Salmon Bread and margarine Chocolate mould
LATE EVENING Milk/cocoa	Milk/cocoa	Milk/cocoa	Milk/cocoa	Milk/cocoa	Milk/cocoa	Milk/cocoa

diet is shown in Table II; this Table constitutes the target with the exception of the figure of 2,500 for calories. The following points concerning the nutrients suggested should be noted.

1. *Calories.*—The number of calories, 2,546, or 2,500 per day as a round number, while lower than that suggested by the National Research Council for a lactating woman, represents approximately the amount of food which can be eaten by nursing mothers who are confined to bed. It has been found almost impossible to get hospital patients to eat a daily diet of 3,000 Calories.

TABLE II

	Calculated average daily consumption of nutrients from the suggested diet	Recommended daily allowance, Food and Nutrition Board, National Research Council
Calories	2,546	3 000
Carbohydrate	298 g.	—
Protein	99 g.	100 g.
Animal protein	60 g.	—
Fat	108 g.	—
Calcium	1·7 g.	2 g.
Iron	13 mg.	15 mg.
Vitamin A	3,429 I.U.	8,000 I.U.
Thiamin	1·3 mg.	2·3 mg.
Riboflavin	2·4 mg.	3·0 mg.
Nicotinic acid	27 mg.	23 mg.
Ascorbic acid	36 mg.	150 mg.

2. *Protein.*—The target figure for animal protein, 60 g. per head per day, is essentially a sound requirement.

3. *Vitamins.—Vitamin A.*—The content of Vitamin A, 3,429 I.U. per head per day, is but half the N.R.C. figure. It could easily be increased, e.g. 2 oz. of sheep's liver per week would raise the figure to the region of 6,000 I.U. per day. The difficulty of obtaining liver today simply rules liver out of such a target diet.

Thiamin (B_1).—The target of 1·3 mg. per head per day is regarded as ample for women living under hospital conditions.

Vitamin C.—In view of the N.R.C. requirement of 150 mg. per head per day, the target figure, 36 mg. per head per day may be regarded as wholly inadequate. Details of the survey certainly show how low is the intake of vitamin C. Recent work on vitamin C requirements has enforced a revision of our ideas as to what is an adequate intake of this vitamin: 36 mg. of ascorbic acid per day are regarded as adequate for nursing mothers under hospital conditions. There are no reasons why this amount should not be secured within the range of an ordinary diet. This corresponds to about 100 mg. per day in the "as purchased" basis, since a combined wastage and cooking loss may amount to 60%.

Total Food Consumption

This includes food supplied by the hospital and the relatives and friends of the patients.

Calories

The mean for all hospitals was 2,284 Calories, not very far below the suggested target of 2,500 Calories. The range was considerable, from 1,901 Calories in a large urban hospital with over 200 maternity beds, to 2,679 Calories in a rural hospital of 30 maternity beds. This cannot be regarded as indicating that rural hospitals are always better off than the city hospitals, because one rural hospital supplied 2,206, and a small town hospital 2,071, and a large city hospital 2,508 Calories per head per day (Table III). With respect to total calories, of nine large

TABLE III

Calories and Protein in Diets in Maternity Wards of Scottish Hospitals
Target: *Calories*=2,500. *Protein*=99 g. *Animal Protein*=60 g.

No.	Total food consumption			Food supplied by hospital		
	Calories	Total protein	Animal protein	Calories	Total protein	Animal protein
1	2,508	88	46	1,941	78	46
2	2,114	79	39	1,690	69	39
3	2,321	79	40	1,829	70	40
4	2,054	68	34	1,615	60	34
5	1,901	78	43	1,648	73	43
6	2,357	70	28	1,495	58	28
7	2,110	84	48	1,929	81	48
8	2,625	107	54	2,270	100	54
9	2,363	81	42	2,173	79	42
10	2,435	86	47	1,894	76	47
11	2,212	80	36	1,695	68	36
12	2,071	76	42	1,845	70	42
13	2,310	84	45	2,054	77	45
14	2,679	93	50	2,647	91	50
15	2,206	79	38	1,986	76	38
Average	2,284	82·1	42·1	1,914	75·1	42·1

city hospitals only one was above the target; of the smaller towns and rural hospitals, two out of six were above the target. Since practically all the beds in our maternity hospitals are occupied, it is of interest to note the number of patients who, in large city and small town and rural hospitals, are supplied with a diet which, in terms of energy, is above or below the number of required calories. The number of beds in the maternity wards of the large city hospitals was 610, in the smaller towns and rural hospitals 263 (see Table IV). Out of 610 patients in the large city hospitals, 68 were above, 542 below the average in calories, i.e. 11·1 and 88·9% respectively. Out of the 263 patients in smaller towns and rural area hospitals, 60 were above, 203 below the target for calories, i.e. 22·8 and 77·2% respectively. Therefore, on the assumption that all the beds were occupied, it is

apparent that out of a total of 873 patients, 745 or 85·3% were below, and 128 or 14·7% were above the calorie target (Table IV).

Protein.—The standard of comparison demands 99 g. of total protein and 60 g. of animal protein per head per day; the average figures were 82·1 g. and

TABLE IV

TABLE SHOWING THE NUMBER OF BEDS IN HOSPITALS IN WHICH THE DIET SUPPLIED BY HOSPITAL AND PATIENTS IS ABOVE OR BELOW THE CALORIE REQUIREMENT

The Target for Calories=2,500.

Large cities			Small towns and rural areas		
No.	Above	Below	No.	Above	Below
1	68		7		24
2		40	8	30	
3		90	12		66
4		60	13		73
5		205	14	30*	
6		30	15		40
9		38			
10		43			
11		36			
	68	542		60	203
Total beds	610			263	
Per cent	11·1	88·9		22·8	77·2

Total above. 128=14·7%
Total below. 745=85·3%

* The only hospital supplied with a diet giving more than 2,500 calories.

TABLE V

TABLE SHOWING THE NUMBER OF BEDS IN HOSPITALS IN RELATION TO PROTEIN IN THE DIET SUPPLIED BY THE HOSPITALS

The Target for Total Protein=99 g. *All but one below.*
The Target for Animal Protein=60 g. *All below.*
The number of beds in hospitals in which the animal protein of the diet is above or below 40g.

Large cities				Small towns and rural areas			
No.	Above 40 g.	No.	Below 40 g.	No.	Above 40 g.	No.	Below 40 g.
1	68	2	40	7	24	15	40
3	90	4	60	8	30		
5	205	6	30	12	66		
9	38	11	36	13	73·		
10	43			14	30		
	444		166		223		40
Total	610			263			
Per-centage	72·8		27·2		84·7		15·3

Total above 40 g. 667=76·4%
Total below 40 g. 206=23·6%

42·1 g. per head per day respectively. The range for total protein was 68 to 107 g. per day, one hospital only exceeding the target; for animal protein the range was 28 to 54 g. per head per day. The deficiency in total protein was 17%, in animal protein it was 30%; the latter is a very serious deficit.

Fat.—In this nutrient there was a 16% deficiency, which, in view of the non-active life of the nursing mother in hospital, may be less seriously regarded; but nevertheless the fat deficiency, coupled with lack of animal protein, has been responsible for the monotony of our wartime dietaries.

Carbohydrate.—This, while generally adequate, could bear some increase (Table VI).

TABLE VI

FAT AND CARBOHYDRATE IN MATERNITY HOSPITAL DIETS WITH THE AVERAGE DAILY AMOUNTS OF EACH SUPPLIED BY THE HOSPITAL AND PATIENT'S FRIENDS

	Fat (g.) *Target*=108 g.			*Carbohydrate (g.)* *Target*=298 g.		
	Hospital	Patient's friends	Total	Hospital	Patient's friends	Total
1	83	·21	104	217	85	302
2	59	15	74	222	62	284
3	71	16	87	226	64	290
4	65	22	87	198	53	251
5	66	7	73	192	43	235
6	42	40	82	222	113	335
7	79	7	86	225	26	251
8	90	15	105	265	47	312
9	85	5	90	273	33	306
10	76	21	97	226	78	304
11	65	22	87	211	69	280
12	78	9	87	220	30	250
13	86	12	98	244	32	276
14	114	2	116	316	3	319
15	77	8	85	249	34	283
Average	75·7	14·8	90·5	233·7	51·4	285·2
Percentage deficiency	30	—	16	22	—	4
% Amount supplied by	84	16		82	18	

Calcium.—An average of 1·28 g. per day with a range of 0·97 to 1·51 g., indicates a deficiency in the diet of nursing mothers.

Vitamins.—*Vitamin A* is seriously deficient in all diets. The average intake was 2,496 I.U. per head per day; the target demands 3,429 I.U. per head per day. The range was 1,886 to 3,750 I.U. per head per day. Only four hospitals could show an intake of over 3,000 I.U. daily, and only one hospital exceeded the target by 300 I.U.

Vitamin B_1.—The target requires 1·3 mg. per head per day, and the average was 1·37 mg. per head per day; the range was 1·09 to 1·80 mg. It should be noted that the figures were satisfactory because of the use of high-extraction flour.

Vitamin B_2 (Riboflavin).—Target 2·4 mg.; average 2·0 mg. per head per day; range 1·60 to 2·43 mg.

Vitamin C.—The figures for vitamin C are of interest in that they are so markedly less than the N.R.C. requirements. As a result of the maximum amount of the vitamin that could possibly be secured by the suggested diet, the target was set at 36 mg. per head per day. Numerous dietary surveys of children and of members of the Forces have indicated that the generally accepted standard for this vitamin is probably far too high. One may criticize the target figure as too low: what can be said in defence of it is that it is about all one can secure in this land of austerity, and the surveys referred to do not entirely condemn it. The target of 36 mg. per head per day was almost attained, the average being 31·2 mg. per head per day. We may admit that the standard is somewhat austere, but the degree to which some hospitals have failed to reach it is interesting. Three large city hospitals and one smaller town hospital were above the target, which means that 74% of hospitals do not reach the target; neither of the rural hospitals reached it.

Food Supplied by the Hospitals

Since the total nutrient consumption falls short of the target in almost every particular, it is obvious that the food supplied by the hospitals must do so to an even greater extent. The extent whereby diets are supplemented by gifts of food varies greatly, but nevertheless no patient in hospital should be dependent on extraneous food supplies. Apart from the fact that the food supplied by relatives and friends is or may be nutritively unbalanced, it is entirely wrong to rely upon such supplies. It should be the aim—as it is the duty—of all hospitals to supply the full quota of required nutrients.

Calories.—The average energy intake by food supplied by the hospitals was 1,914 Calories per day (Table III). The range was 1,495 to 2,647 Calories. The range for a single day was tremendous, the highest being 3,002 Calories and the lowest 1,418 Calories. Out of 15 hospitals surveyed only one, a rural hospital of 30 beds, supplied a diet which exceeded the target for calories. In terms of possible patients in 873 beds in the hospitals examined, 30, i.e. 3·4%, received a diet supplying over 2,500 Calories per day. Four out of 15 hospitals gave over 2,000 Calories, which means that 73% of hospitals supplied, for their maternity patients, a diet containing less than 2,000 Calories (Table III). After a careful survey of diets as eaten daily for seven consecutive days by patients in the wards of 15 hospitals, it is fair comment to state that such figures are worthy of attention and point to a general inadequacy of dietary intake by far too many nursing mothers in the maternity wards of Scottish hospitals.

Protein.—The hospitals supplied on an average 75·1 g. of total protein and 42·1 g. of animal protein per head per day, the range being for total protein 58 to 100 g., and for animal protein 28 to 54 g. In terms of total protein, only one hospital gave in its dietary more than 99 g. per head per day—the amount was 100 g. It has been and still is very difficult to obtain sufficient amounts of animal

protein. That no hospital reached the requirement of 60 g. per head per day, that the average intake was 42·1 g., and the minimum 28 g., indicate not only a serious deficiency in first-class protein but a faulty catering in certain hospitals. This statement is supported by the observation that, in 30% of the hospitals surveyed, nursing mothers received less than 40 g. of animal protein, and by the data in Table V, where the number is given of patients in the hospitals in which the

TABLE VII

CHIEF SOURCES OF CALCIUM (mg.) IN DIETS SUPPLIED BY HOSPITALS
Target=1·70 g./*Head*/*day*.

No.	Milk.	Cheese	Potato	Cabbage	Bread	Porridge	Starchy foods*	Rice and raisins	Broths and soups		Total
1	969	57	7	12	69	12	56	22	43	—	1,315
2	697	24	9	13	67	12	64	9	54	—	1,007
3	950	49	5	12	88	13	60	—	45	—	1,303
										Split peas	
4	508	—	6	—	59	7	80	26	5	40	918
5	720	—	10	—	76	7	212	—	70	—	1,273
6	812	—	5	12	96	12	96	20	30	—	1,146
7	636	24	6	12	70	13	173	—	37	—	1,114
8	860	48	8	1	80	—	172	—	57	—	1,381
9	708	32	13	7	91	13	95	24	76	—	1,145
10	1,049	16	6	6	87	14	123	—	60	—	1,411
11	953	40	5	5	75	12	191	—	69	—	1,381
										Ice cream	
12	674	—	6	3	71	10	45	—	47	41	933
13	835	73	9	7	89	10	98	—	43	—	1,299
										Gruel	
14	846	—	—	—	127	16	111	—	25	324	1,514
15	836	24	5	8	94	11	85	—	53	—	1,363
Av.	803·5	25·8	6·7	6·5	82·6	10·4	110·7		49		1,233·5
%	65·1	2·3	0·54	0·53	6·7	0·84	9·0		4·0		

* Starchy foods=cornflour, cocoa, semolina, chocolate mould, rice.

animal protein of the diet is above or below 40 g. That 27·2% of the patients in large city, and 15·3% in small town and rural hospitals received less than 40 g., indicates the magnitude of the wartime deficiency in animal protein.

Fat.—The amount supplied averaged 75·7 g. per head per day; the range was 42 to 114 g.; with the exception of these two extremes the range was between 59 and 90 g. of fat (Table VI). The hospitals have suffered, as have all in this country, from a deplorable lack of dietary fat. The 30% deficiency of fat in the hospital diet is, even for wartime conditions, too great. That patients' friends supplied 16% of the requirement of fat would indicate that the hospital deficiencies of 30% could certainly be lessened.

Carbohydrate.—The average figure was 233·7 g. per head per day; the range was 192 to 316 g. The deficiency in the hospital supply is 22%. The deficiency in energy in terms of foods supplied by the hospitals is striking. None the less striking is the fact that the patients' friends and relatives supplied 16 and 18% respectively of the total intake of fat and carbohydrate (Table VI).

Minerals.—The average figures for calcium and iron were 1·23 g. and 10·63 mg. per head per day respectively (Tables VII and VIII). The intake of these minerals was comparatively constant. The chief sources of calcium and iron as supplied

TABLE VIII

CHIEF SOURCES OF IRON IN MG. IN DIETS SUPPLIED BY THE HOSPITALS

Target=13 *mg./head/day.*

No.	Milk	Eggs	Meat	Liver	Bread	Porridge	Potato	Cocoa	Broth and soups	Total
1	0·81	0·42	0·74	·70	1·71	0·90	0·55	1·71	2·10	11·47
2	0·58	0·42	0·82	—	1·65	0·89	0·76	2·00	1·71	10·60
3	0·79	0·82	1·30	—	2·17	1·01	0·42	1·29	1·45	10·33
4	0·51	0·24	0·93	—	1·45	—	0·50	0·72	0·10	9·03
5	0·60	0·92	0·90	—	1·90	0·50	0·87	—	3·00	9·80
6	0·69	0·21	0·68	—	2·35	0·88	0·43	0·17	1·81	7·70
7	0·53	2·02	1·30	—	1·74	0·99	0·55	—	1·59	13·00
8	0·72	0·39	0·88	0·97	2·27	1·82	0·57	0·57	2·59	13·00
9	0·66	0·55	0·65	—	2·56	1·00	1·08	0·29	2·71	10·80
10	0·87	0·90	1·10	—	2·10	1·05	0·49	—	2·11	10·04
11	0·79	0·80	0·66	—	1·83	0·88	0·39	—	2·54	8·61
12	0·56	0·21	0·79	1·11	1·75	0·73	0·05	—	1·60	9·32
13	0·70	0·21	0·99	0·83	2·19	0·75	0·80	—	1·17	13·22
14	0·71	0·22	1·43	—	3·12	2·49	0·60	0·72	0·75	12·50
15	0·70	0·54	0·90	—	2·53	0·84	0·44	0·57	1·97	10·42
Average	0·68	0·64	0·94		2·10	0·78	0·57		1·80	10·63
Percentage	6·4	6·1	8·3		19·8	7·3	5·4		1·7	

by the hospital diets are shown in Tables VII and VIII.. The supreme importance of milk as a source of calcium is shown in Table VI; the value of liver, eggs, national bread, and potatoes as sources of iron is shown in Table VIII. It is worthy of note that milk, in adequate amount, cannot be ignored as a source of iron: two pints of milk (1,150 g.) will give 1·15 mg. of iron. The best source of iron is national bread. The value of a combination of milk and cocoa should be noted.

Vitamins.—Vitamin A.—The target for vitamin A is 3,429 I.U. per head per day. The average amount of vitamin A supplied in hospital diets was 2,266 I.U. per head per day; the range was 1,621 to 3,212 I.U. No hospital reached the target, the largest intake in any one day being 3,313 I.U., the lowest 1,232 I.U. The greatest deficiencies were in the large city hospitals, in two of which 1,711 and 1,621 I.U. per head per day were supplied. The chief sources of this vitamin as supplied in

hospital diets are milk, butter, margarine, and carrots (Table XI). The deficiency in vitamin A indicates the need for more milk, fats, and vegetables, particularly carrots. The value of sheep's liver as a source is so important that every effort should be made to increase the amount of liver in the diets of nursing mothers.

Vitamin B_1.—With an average intake of 1·25 mg., vitamin B_1 was satisfactory.

TABLE IX

CHIEF SOURCES OF VITAMIN A (I.U.) IN DIETS SUPPLIED BY HOSPITALS

Target=3,429 I.U.

No.	Milk	Margarine	Butter	Eggs	Cheese	Liver	Cabbage	Carrots	Soups and broths	Miscellaneous	Total
1	565	256	160	123	91	750	78	—	39	84	2,146
2	813	208	100	123	39	—	60	—	233	179	1,755
3	554	384	—	118	78	—	75	1,133	210	73	2,635
4	360	288	160	261	—	—	—	363	53	226	1,711
5	840	304	120	280	—	—	—	800	103	279	2,726
6	678	—	—	62	—	—	48	533	147	53	1,621
7	742	208	140	529	39	—	81	—	48	371	2,158
8	1,004	288	160	116	78	1,050	—	—	142	374	3,212
9	413	297	160	266	52	—	45	—	176	243	1,652
10	612	240	—	263	26	—	42	—	190	507	1,881
11	1,112	224	80	264	65	—	33	—	167	227	2,172
12	787	240	100	62	—	1,200	21	107	160	139	2,836
13	474	208	200	62	117	900	45	—	281	822	2,914
14	494	528	240	75	—	—	—	—	140	456	1,863
15	976	324	260	159	39	—	51	—	121	784	2,714
Average	694·9	266·5	125·3	184·2	41·6		38·6	195·8	147·3		2,266
Percentage	30·7	11·8	5·5	8·1	1·8		1·7	8·6	6·5		

NOTE.—The larger variations in the vitamin A content of milk are due to the difference between summer and winter supply.

Vitamin C.—With 23·5 mg. per head per day as the average intake, vitamin C was far short of the target requirement of 36 mg. per head per day. The amount of vitamin C in hospital diets was, even in terms of the target, far too low in the majority of the hospital diets examined (Table X). Two hospitals passed the target figure, one by 2 mg. the other by 17 mg. That with a ration of oranges two hospitals—and the only two which were in receipt of this ration at the time of survey—should fail to reach the target is comment enough on the need for dietetic advice and supervision of hospital diets. The aim must be to increase the supply of milk, green vegetables, potatoes and fruit, particularly oranges.

Food Contributed by Patients' Relatives and Friends

While relatives and friends of the patients contributed little protein, they did supply a considerable percentage of the total fat and carbohydrate consumed: this was particularly true of the large city hospitals (see Table VI). Table VI shows that the patients supply 16% of the total intake of fat and 18% of carbohydrate. In terms of calories this extraneous supply varied greatly, ranging from 32 to 862 Calories per head per day, with an average of 370·3 Calories per head

TABLE X

Chief Sources of Vitamin C (mg.) in Diets Supplied by Hospitals

Target=36 *mg./head/day.*

No.	Milk	Potato	Cabbage	Green Vegetable	Broths and soups	Oranges	Total
1	5	3	2	2	3	—	15
2	7	21	6	2·5	1·5	—	38
3	9	3	—	—	4	—	16
4	4·5	1	1	1·5	2	—	10
5	5	2·5	0·5	2·5	0·5	—	11
6	10	2·5	—	2	1·5	—	16
7	7·5	2	6	3·5	1	—	20
8	6	4	0·5	2	0·5	5	18
9	13	3	2	1·5	0·5	5	25
10	18·5	3·5	4·5	6·5	2	—	35
11	6	2	8	1	3	—	20
12	14·5	28	2·5	5	3	—	53
13	11·8	8	1	1·4	3·8	—	26
14	10	8	—	—	4	—	22
15	10·5	4·5	4	6	3	—	28
Average	9·2	6·4	2·5	2·5	2·2		23·5
Percentage	39·1	27·2	10·6	10·6	9·4		

TABLE XI

Milk in Pints per Head per Day in Maternity Hospitals

Priority: *nursing mothers*=1 *pint per head per day. Non-priority ration*=0·5 *pint per head per day.* 1 *pint*=568 *c.cm.*

No.	Large cities	No.	Small towns
1	1·42	7	0·94
2	1·02	8	1·25
3	1·40	12	1·00
4	0·89	13	1·22
5	1·04		
6	1·19		
9	1·08		Rural areas
10	1·40	14	1·24
11	1·40	15	1·23

per day. With the exception of vitamin C, which depends so much on the availability of fruit, the supply of other nutrients was of no significance. The only source of animal protein supplied by friends was eggs, 0·36 egg per head per day, equal to 2·16 g. protein.

The Chief Deficiencies and the Means for their Improvement

Milk

The outstanding contribution which milk makes in supplying animal protein, calcium, and vitamins A, B_1, and riboflavin has been emphasized. Most hospitals supply one pint of milk per head per day, and it would appear from Table XI that, in respect of milk, the location of the hospital plays no very significant part:

TABLE XII

A Comparison of the Calories and Nutrients in Hospital Diets: in One Pint of Milk: and in the Suggested Diet

	Calories	Total protein g.	Animal protein g.	Fat g.	Calcium g.	Vitamin A I.U.
Hospital diet average per day	1,914	75·1	42·1	75·7	1·23	2,096
1 pint of milk (extra) ..	360	19·0	19·0	21·0	0·68	800
Total	2,274	94·1	61·1	96·7	1·91	2,896
The Target	2,500	99	60	108	1·70	3,429

four out of nine large city hospitals gave more than the rural and small town hospitals. The average amount of milk in the hospital diets was 1·18 pints of milk per head per day. In view of the serious deficiency of animal protein, fat and vitamin A, it is evident that nursing mothers should have, *in whatever form it may be most acceptable to them*, two pints of milk per day: this ought to be a dietetic axiom for maternity hospitals. This requires that hospital staffs and the patients should be informed of the value of milk and nursing mothers should be encouraged to take the full amount.

In Table XII, the calories, total and animal protein, fat, calcium and vitamin A of the hospital diet are compared with the content of these nutrients in one pint of milk, the diet, to which one pint of milk has been added, and the target. The means of further increasing the calories, minerals and vitamins will readily come to mind: for example, butter, eggs, cheese, liver, potatoes, etc. The data in Tables VII to XI, showing the chief sources of minerals and vitamins in hospital diets, indicate those foodstuffs the increased use of which will make for dietary improvements. It is hoped that the serious protein and vitamin A deficiencies will be reduced in the near future by a greater supply of milk, bacon, eggs and liver.

Until then, and even then, concentrates of vitamins A and D, as cod liver oil, vitamin C—in the form of orange juice—and extract of rose hips must be given to all nursing mothers. This is not said without some knowledge of the difficulties in persuading not a few to take capsules of vitamin A and D and orange juice. There is no reason why orange juice should be presented in any but an attractive form. The serious deficiency of vitamin C can be partly made good by a greater use of green vegetables and potatoes properly cooked and speedily served. The value of fish, particularly fatty fish, as a source of animal protein and vitamins should not be overlooked. A greater variation in the design and presentation of diets would do much to increase the amount of nutrients and, stimulating appetite, encourage a greater intake of food.

While criticism of not a few hospital dietaries cannot be evaded, the main import of such an investigation is to indicate the deficiencies and the means for their relief. In the unprecedented difficulties which have dogged the steps of all who cater, be it for large or small groups, it is remarkable that the deficiencies have not been much greater. To maintain a satisfactory dietary for patients in maternity wards of hospitals it is necessary to have dietitians responsible for ordering foodstuffs, framing menus, management and control of kitchens, and for the supervision of all diets—general and special. Only by the appointment of dietitians in all large hospitals, as also for groups of smaller hospitals, can the principles of nutrition be adequately translated into the practice of hospital dietetics.

We should like to take this opportunity to thank Miss Adamson for the excellent manner in which she carried out the dietary surveys in the maternity wards of the fifteen hospitals investigated, and also the Medical Officers of Health, Medical Superintendents, Matrons, and Ward Sisters for their interest and helpful co-operation in the work. We wish, too, to thank the Scientific Advisory Committee and Sir Andrew Davidson, Chief Medical Officer of the Department of Health for Scotland, for permission to publish the results of this survey.

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SOCIAL SERVICE FOR A MEDICAL WARD

BY

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On the eve of new legislation which will affect the results of illness for hospital patients, it seems opportune to discuss the present need for an almoner's services on a medical ward and what it is likely to be in the future. In 1943 a study was carried out in this department of a group of patients admitted to a medical ward during a period of six months, and it was concluded that 70 per cent. of the patients required an almoner's supervision or help (Brown and Carling, 1945). Since that date an almoner has been attached as social worker to the department, and her duties have included the social care and supervision of patients while in the ward and after discharge. A further follow-up study has now been carried out in order to find out what difference this has made. The main questions to be answered are: what proportion of medical patients require the services of an almoner, what are the main social problems with which the almoner has to deal, how much almoning time is needed if medical social supervision is to be effective, and how can the almoner's services be integrated most efficiently with those of the medical staff?

MATERIAL

Collier Ward, whose patients have provided the material for both the studies mentioned here, is in the charge of the Nuffield Professor of Clinical Medicine and is divided into accommodation for ten men and eleven women. The admissions during a period of six months from August, 1941, to January, 1942, had been chosen for the first investigation; for the second one it was decided to study the patients admitted during the twelve months from November, 1943, to October, 1944, and they were followed up between one and two years after their admission to hospital.

In the twelve months under review 355 patients, 180 male and 175 female, were admitted; the ages ranged from 5 to 77, but the majority were between the ages of 21 and 50. Over 80 per cent. came from Oxford or the surrounding area served by the Radcliffe Infirmary; their social and occupational status varied between wide limits, but, apart from the 10 per cent. who were members of the services, the majority of the men were employed either on agriculture or industrial work such as the war-time adaptation of the motor trade, while more than half the women were housewives. Nearly a third of the patients were admitted with gastro-intestinal complaints, and another large group had diseases of the blood; the average length

* With a grant from the Medical Research Council.

of stay in hospital was sixteen days. Sixty patients, or just over 17 per cent., died within two years of admission to hospital. Complete records of 257 of the surviving patients were obtained; 183 of them were seen, and reports were received of 74 others. A further eleven patients were known to be alive and working full time, although no detailed information could be obtained about them. Twenty-seven patients could not be traced; eight of these were members of the services, and the rest were evacuees, casual labourers, and others who had left the district.

At the time of the follow-up, 134, or 38 per cent. of the patients, were cured, and 130, or 37 per cent., were still suffering from the disease which had caused admission; 17 per cent. were dead, and 8 per cent. lost sight of. A review of the activities of the surviving patients provides a less discouraging impression. Although only 38 per cent. of the patients admitted had been cured, 215, or 60 per cent., had returned to full-time work, 30 (8·5 per cent.) were doing part-time work, and only 23 (6·5 per cent.) were unable to pursue their usual employment. In about 70 per cent. of the surviving patients the capacity for work was unaltered, though in the remainder it had been reduced as a result of the illness. In only a small proportion of cases was the earning capacity significantly reduced. The review of this group of patients one to two years after in-patient treatment led to revision of the diagnosis in four, and suggestions for further medical treatment or supervision in 31. Twelve patients needed further treatment for their original disease; eight for diseases which had developed since their discharge from hospital; seven were referred to other departments for advice and treatment, and four patients were in need of regular medical supervision.

The Need for Social Service and Supervision

Although it had previously been concluded that 70 per cent. of the patients required an almoner's supervision or help, in the present series the proportion was found to be less; including those who merely needed advice or minor services, only 54 per cent. needed any form of help from the almoner. The two series of patients are, however, not entirely comparable, and the larger proportion of patients in the second series who had relatively short illnesses is probably mainly responsible for the difference.

For a short acute illness, whether the result is fatal or whether recovery is complete, the problem is medical rather than social and it is during a long illness that the almoner's services are most frequently required. Including those whose illness ended fatally, 44 per cent. of the patients were incapacitated for longer than three months, and of these 36 per cent. had serious social problems, whereas similar problems were found only among 13 per cent. of the others. A group of patients with infective hepatitis who were admitted for purposes of medical research presented scarcely any social problems. They had only a short illness and made good recoveries, and most of the civilians would not normally have come into hospital at all. The service patients with infective hepatitis, and other service

patients with short illnesses who later returned to units, suffered no financial loss through illness, and adequate arrangements were made for their convalescence and general after-care through the normal service channels; only those who were in hospital for a long period and who might need to be discharged from the service on account of their illness needed social supervision from the hospital. Excluding the patients with infective hepatitis and the other short-term service patients, about 60 per cent. of the present series needed some social help or supervision, although only 24 per cent. had serious social difficulties as a result of their illness.

Serious Social Problems Resulting from Illness

The most serious social and economic problems which patients had to face as a result of illness were caused by loss of wages, by enforced change of employment, or by domestic difficulties, especially the care of young children. Seventy patients (22 per cent.) had problems which fell into one or more of these categories, and ten more had difficulties of various kinds which required detailed assistance or long-term planning and supervision by the almoner.

Financial Problems.—Twenty-four patients (8 per cent.) had financial difficulties serious enough to cause acute anxiety or to require material assistance; all except two of these problems resulted from loss of earning capacity through long illness, while the others were caused by expenses connected with illness. The higher rate of sickness benefit in the proposed new social insurance scheme would have eased but would not completely have removed these problems. Even if sickness benefit may be continued at the full rate for three years, it is still the patients whose illness lasts less rather than more than three months who are likely to benefit most by it. The patients with short periods of incapacity in this series supplemented their sickness benefit with savings, and such temporary difficulties or worries as their sudden drop in income may have caused them were not serious enough to have left much impression on their minds by the time the follow-up was undertaken. A higher rate of sickness benefit would, however, have been a welcome help at the time, and, had it not been for the opportunity to save which full employment and a good general level of wages had given, their need would have been considerably greater.

The patients who had serious financial difficulties had almost all remained off work for three months or longer, and even with higher rates of benefit this would entail a serious drop in the standard of living. A married man with one child would receive £2 5s. per week sickness benefit. Even the cow-man who had been getting £4 per week would have found this difficult to manage on for a long period, while the proportionate drop in income would be more serious still for the teacher whose salary was normally £500 per annum and who lost three terms' salary through illness, or for the sheet metal worker who had been earning £8 per week and had to remain off work for six months. Seven patients in our series had to be referred to public assistance, and with a higher rate of sickness benefit such a course

could no doubt have been avoided. This would have been a great advantage on psychological grounds; but the public assistance allowance, which took account of variations in rent, left them, in fact, rather better off materially than they would be with the new benefits.

The amount of material assistance which the almoner was able to give the patients who were in financial difficulties was limited. Grants of various sorts were obtained from charitable sources to cover emergency needs or to enable patients who were living on a reduced income to obtain extras, and arrangements were made for the patients already mentioned to apply for public assistance. The almoner's main task was, however, to make sure that patients received all the statutory benefits to which they were entitled, and especially to discuss with the patients or their relatives how their difficulties could best be met and to help them to plan ahead. Often it was found that both the wage earners and their wives were worried but did not know what to expect and clung rather vaguely to the hope that " they would manage somehow." The almoner, who was in close touch with the medical staff and could get from them an approximate idea of the prognosis at an early stage, was able to foresee the future difficulties more clearly than the patients and could help them to plan constructively. The results suggested that this form of social service was quite as important as the provision of material help, and there is no reason to expect that the need for it in the future will be any less than it has been in the past.

Employment.—Thirty-two patients (10 per cent.) required assistance in changing their employment, and twenty more (6·5 per cent.) adjusted or changed their employment without assistance. The Ministry of Labour's interim scheme for resettlement of disabled persons, precursor of the Disabled Persons Employment Act, was in force at the time, and extensive use was made of it. Employment conditions were exceptional: the demand for labour of any sort was acute and National Service restrictions were extensive. It happened, therefore, that the Ministry of Labour's special machinery was often used rather as a convenient method of securing release from a previous job than as a means of finding a new one. Thus, although twenty-nine patients required medical evidence before they could be released from their previous employment, only seven had their new work found for them by the Ministry of Labour, and the rest found jobs for themselves. This situation has already changed, and although registration under the Disabled Persons Act may help patients to compete in an open market, the difficulties of finding work which is adequately paid but still within their physical limitations are likely to increase.

The almoner kept in close touch with the local Disablement Rehabilitation Officers, and repeated consultations with them were sometimes necessary. When suitable work of a slightly different kind or under modified conditions could be provided by previous employers, patients were usually able to arrange this for themselves, but they were advised to get in touch with the almoner in case of difficulty, and occasionally her assistance was required.

A recommendation for change or adjustment of employment is a medical matter, and any decision about it must rest with the medical staff, but for many of these patients no action would have been taken by the hospital if the question had not first been raised by the almoner. This does not imply that the medical staff failed to take into account the type of work which patients had been doing or the need to alter it when necessary, but rather that house physicians were apt to think that telling a patient to take a different job was quite sufficient. As patients themselves usually agree to such suggestions without further comment, whether they expect to be able to put them into practice or not, some experience of what usually happens to such patients later is required before the need for more positive action is realized. The previous follow-up provided examples of patients who had found the greatest difficulty in obtaining suitable work by themselves, and of others who were not employed but could and should have been trained for some work within their range of physical activity. Patients should be encouraged to make their own arrangements when there are reasonable grounds for expecting them to succeed, but the results of their own efforts should be ascertained in case further help is needed. Present experience confirmed the impression that, when patients are referred to the Ministry of Labour for rehabilitation, the hospital must continue supervision at least until the patient has returned to work.

Domestic Problems.—The difficulty of caring for patients' homes and families while they were in hospital, or of looking after them at home when this was necessary, was mainly solved by the patients themselves with the help of relatives, friends, and neighbours. Often this caused inconvenience and, if a wage-earner had to remain at home, loss of income. Housewives were apt to worry about how their families were managing without them, or to feel disturbed at " putting upon " other people, but the problem caused serious difficulties only for thirteen (4 per cent.) of the patients, of whom nine were housewives with young children. Neither of the two patients whose children had to be admitted to public assistance nurseries regarded this as satisfactory, and another young woman discharged herself against advice rather than consent to such an arrangement; some prejudice against letting the children go away from home would have been likely in any case, but it would undoubtedly have been lessened if application through a relieving officer had not been necessary. Exhaustive attempts were made to obtain domestic help for a patient with cirrhosis of the liver whose need was especially acute, but without success. Housewives who have always been accustomed to doing their work themselves do not welcome the presence of a stranger in the home, and any system of home helps is likely to have disadvantages, but there is scope for a much greater extension of this service; some local authorities already provide home helps, but it is encouraging that it is proposed to include such facilities in the new health service, and it is to be hoped that all local authorities will in future make full use of their powers in this connexion.

Personal Problems.—Almost all the major social problems and many of the less serious ones caused either immediate anxiety or apprehension about the future;

some made it necessary for patients to make difficult or unpleasant decisions. Illness of a wage-earner or of a housewife might, for different reasons, throw a strain on the normal family relationships and cause friction or misunderstandings, and when dealing with material difficulties the almoner had to take these personal problems into account. Fourteen of the patients had personal problems resulting from their illness which seemed serious enough to be specially noted. One, a married woman who was found to have a luetic infection, required much encouragement and help in dealing with a difficult domestic situation and in persisting with treatment, although no material assistance was required.

Subsidiary Forms of Hospital Social Service

Arrangements for Convalescence.—In so far as convalescence implies merely an extension of hospital treatment in a modified form, it is a medical rather than a social need, but some degree of social supervision is desirable when arrangements for it are made. Routine convalescent treatment at cottage hospitals or local recovery units was arranged for thirty-six (12 per cent.) of the civilian patients, and in few instances did the special circumstances of the illness present difficulties. A young woman recovering from puerperal sepsis who needed to take her baby with her was the only one for whom a vacancy could not be obtained. An elderly lady recovering from pneumonia could only be placed after much difficulty and delay, while two patients were unable to obtain the special diets which they needed. Convalescence for two other patients would have involved delay and, as satisfactory arrangements could be made for them to be looked after at home, they were sent home instead.

Complaints of any sort by the patients were extremely rare, and the contrast in this respect with the previous follow-up is surprising. In the previous series a widespread dissatisfaction with facilities for convalescence was noted which was not confirmed this time. The reasons for this difference are not fully clear. Local cottage hospitals had been used as extensively as before and, although the large Red Cross convalescent home for women offered better facilities than had been available previously, it was sixteen miles from Oxford and distance from home had been a common complaint in the earlier series. Although this suggestion can only be put forward tentatively, the fact that the almoner always had an opportunity to discuss the arrangements for convalescence with these patients in advance may have had some effect on their subsequent attitude. Some patients would have preferred to remain in the hospital ward, some would rather have gone home at once, and others who wished to be sent to a particular district or convalescent home had for various reasons to be sent elsewhere; all agreed, however, after the difficulties had been fully discussed with them, that it was in their interests to take advantage of the facilities, and they went prepared to make the best of the situation, even when they would have preferred something different. It is possible that they would have settled down less happily if they had felt that they were being disposed

of for the hospital's convenience, that convalescence was really quite unnecessary, or that they could and should have been sent nearer their own homes. Examples of all these attitudes were discovered and dealt with in the present series before convalescence was arranged, and the results of the previous follow-up suggest that insufficient attention to them caused the refusal of some patients to accept convalescent treatment and the dissatisfaction with it of others.

Three patients were sent to distant convalescent homes, and here the problem was somewhat different: a complete change of surroundings in a congenial atmosphere was a primary recommendation, and two of the patients had already left the ward. Particular care was taken to choose the home which seemed most likely to suit the temperament of the individual patient.

Chronic Institutional Care.—Only six of the patients needed chronic institutional care and for three of them satisfactory arrangements could be made. Two adult patients who had to be transferred to public assistance institutions were acutely dissatisfied, and a boy of thirteen who was dying of lymphosarcoma of the lung presented a particularly difficult problem. The numbers are too small to justify any general comment, and these examples merely illustrate a defect in our present services which is already well known. Social supervision is especially necessary when arrangements are made for patients with incurable illness who may have to remain under institutional care for the rest of their lives, but an almoner can do little to ease the situation when there is no satisfactory accommodation available.

Transport.—The difficulty of obtaining transport to and from hospital is often a serious one for patients, especially those living in country districts, and we were fortunate in having at our disposal the services of the W.V.S. Volunteer Car Pool throughout the period covered by this survey. Car journeys were arranged for fifty-three (17 per cent.) of the patients; nine patients needed more than one journey, and most of these attended hospital by car over a considerable period. About a third of the single car journeys were to destinations outside the hospital area, some of them as far distant as Exeter or Chester. Since at that time the service was entirely free and, except in rare instances, the journeys could be arranged with a minimum of time and trouble, car transport ceased almost to be thought of as a serious problem, but the previous follow-up provided examples of patients who on account of travelling difficulties had been unable to receive medical treatment or supervision which they needed.

Constant vigilance was necessary to make sure that the W.V.S. service was not abused. This is equally necessary with the present Hospital Car Service, and added work is involved in meeting the cost of the journeys, for which the hospital has now to be responsible. Only a few ambulance journeys were arranged directly by the hospital, apart from routine convoys to the two large convalescent homes, as most of the cottage hospitals make their own arrangements with local ambulance services. The expense of local ambulance journeys did not cause much difficulty, but two patients who had to be sent for long distances by ambulance required substantial help with the cost.

Adequacy of Hospital Social Service Provided

An attempt had been made to provide hospital social service for all the patients in the second series and to continue social supervision after discharge for such patients as needed it, but it remained uncertain until the second follow-up had been completed whether, in fact, the service provided had been adequate. The results obtained were satisfactory in this respect. In the earlier follow-up it was estimated that, while 20 per cent. of the patients had received some form of hospital social service, nearly 50 per cent. more should either have been helped by an almoner or referred by her to some other social agency, and 12 per cent. still presented some acute social need at the end of a year. When the second follow-up was carried out (between one and two years after the patients' admission) only six patients (2·3 per cent.) were found to have medical social problems for which further help was required and there was no evidence that any of the other patients had at an earlier stage been in need of help from the almoner which they had not received.

Of the six patients who needed further assistance, one was in general financial difficulties, two needed help in obtaining extra milk, and three were fit for work but not employed. The social welfare of the first patient was no longer strictly speaking our responsibility, as he had by then moved to London and was under the care of another hospital; much the same applies to one of the patients needing extra milk who had previously been referred to the tuberculosis authorities for further supervision. One of the patients who wanted work had only spent one night in hospital and had not been seen by the almoner; in any case he was over sixty-five and the possibility of getting him suitably placed was doubtful. Attempts had already been made through the Ministry of Labour to find suitable work for one of the other patients and the lack of an adequate bus service near his home had proved the main stumbling block; as he had other sources of income and was well occupied at home, no further action had been taken. The last patient could have been helped to find work sooner if his need had been discovered, but he was a man of low mentality and had not responded to a written follow-up enquiry.

The residual medical social problems discovered were not only numerically smaller but also individually less serious than those disclosed by the previous follow-up and, although the proportion of patients who required social supervision appears to have been rather higher in the earlier series, this would not be sufficient to account for the difference in the final results. The value of the advice given to patients who needed no material assistance and for whom no serious difficulties arose cannot easily be determined, but it is possible that potential problems were prevented by this means. For instance, the failure of some patients to obtain certain statutory benefits to which they were entitled, especially when they became involved in the complexities of national health insurance procedure, was commented on by the writers of the previous report; eligibility and methods of application were a frequent subject of enquiry among patients in the present series, and it is satisfactory to note that, with the exception of two (both of whom had been offered

further help if they had cared to avail themselves of it), all the patients who were entitled to such benefits had received them.

Methods of Hospital Social Service

Patients in the present series were interviewed briefly by the almoner as soon as possible after admission in order to find out whether any immediate help was required and to get a rough idea of what problems might arise if the illness should prove to be a long and serious one. Patients admitted from the waiting-list had usually been seen already by the almoner in the out-patient department, and sometimes her assistance had been needed in making arrangements for admission.

As soon as the medical staff were able to state the probable prognosis and general recommendations for treatment and after-care, patients who were likely to have social difficulties were interviewed again at greater length and at this point the relatives were, if necessary, seen as well. Every effort was made to ensure that any necessary medical information had already been given by the medical staff. Often it was found that patients " hadn't liked to ask," and relatives were particularly diffident about " bothering the doctors." When the patients or relatives had been told as much about the illness as the medical staff considered advisable, the almoner could proceed with the task of ensuring that any necessary social adjustments could and would be carried out.

It is, of course, a fundamental principle of social case-work that individuals should be encouraged to make the fullest use of their own resources and those of their families. Patients who thought their difficulties insurmountable were sometimes able to find their own solution once they had been helped to face the issue clearly, and, even when material assistance was needed, it was provided as part of a general plan to restore the patient to independence as soon as possible.

The amount of work required varied according to the type of service needed. The subsidiary services, which were required most frequently, seldom involved any great expenditure of time. Provision of routine convalescent treatment may be quoted as an example: for this, the necessary information had to be given to the matron of the convalescent home and certain other routine details completed, the patients were seen and the arrangements discussed with them, and the ward was finally notified when the vacancies were obtained. Where special diets or other requirements made it more difficult to find a suitable vacancy, more detailed work might be needed, and for one elderly lady with bronchopneumonia eight telephone conversations, seven interviews with the patient or her relatives, a visit to her brother's home, and consultations with the medical staff were necessary before the matter could be satisfactorily settled.

Provision of material assistance required correspondence or telephone conversations with outside agencies as well as interviews with the patients concerned, while contact between almoner and patient over a considerable period might be needed when personal problems were involved. The amount of time required

generally depended less on the gravity of the individual problems than on the number of different ones found together. The more complex the network of interdependent problems—personal, financial, occupational and domestic—the longer the time required to unravel them. Only twenty-seven patients required intensive social case-work, but the amount of time spent on them was considerable. The work involved for one of these patients who represents an average sample was spread over a period of five months and included thirteen detailed interviews with patient or relatives and one with a Ministry of Labour official, three visits to the patient's home, six letters, and five consultations with the medical staff, in addition to shorter conversations with the medical and nursing staff which were not recorded.

Staffing Requirements

The earlier report indicated that the almoner's department had not been able to supply more than 30 per cent. at most of the hospital social service required. At that time there were only three trained almoners for a hospital of 500 beds, and they were in addition considerably burdened with routine duties unconnected with medical social work. It appears from the results recorded here that the social supervision of the second series was adequate, and on this basis the amount of almoning time needed to provide such a service can be discussed. The time which the almoner required for this work depended largely on the complexity of the problems and on the type of service required, but the proportion of patients whose assistance involved numerous interviews and home visits or long correspondence was relatively small (see Table). The almoner concerned was also engaged on other work, and the number of hours spent on each varied from time to time, but the experience gained suggests that to provide adequate hospital social service for medical patients a ratio of two almoners to 100 beds and the corresponding out-patient clinics would be sufficient. This assumes, however, that the almoners would not be responsible for assessment and other such administrative duties, and that they would have sufficient clerical help, i.e. one secretary for the two almoners.

Co-operation with the Medical Staff

The opportunity for close contact with the medical staff while undertaking the work discussed here was an immense advantage to the almoner in her work. Attendance at the weekly departmental staff meeting enabled her both to obtain advice about the after-care of individual patients and to report what had happened to them at a later date, and also to discuss matters of general policy affecting her work. At a later period than that covered here, a weekly ward round was instituted at which all the medical staff of the unit were present and which the almoner was invited to attend; this has proved a valuable additional means of keeping in touch with what is being done for patients on the medical side and of discovering any social implications of their illness at an early stage.

The suggested ratio of two almoners to 100 beds, with out-patient clinics in addition, would not allow for as much time spent on the ward as was possible here, and it would be necessary to rely to a greater extent on referral to the almoner by the medical staff of patients who required her help. It was noticed in the present series that some of the patients who developed the most serious problems were those who had not been referred to the almoner for assistance, and valuable time would have been lost if they had not been referred till later when their problems became more apparent. Experience gained here strengthens the conviction that the essence of constructive medical social work is to start treating potential problems before any obvious social complications have had time to develop. It is therefore suggested that, in addition to the patients whose need for social service has been noted by the medical staff, or for whom social investigation might be useful for diagnostic purposes, the almoner's attention should be drawn at the earliest opportunity to all patients (*a*) who are unlikely to return to full activity within three months, (*b*) who will need to modify their normal life, whether in respect of employment, dietary habits, or in other ways, or (*c*) who, for no very obvious reason, have not settled down happily in hospital or are unwilling to carry out the medical recommendations.

Conclusion

It would be unwise to stress unduly the general implications of a limited survey; the difficulty of defining social problems and the complex network of personal and material factors that give rise to them make any attempt at statistical analysis dangerous, and the figures quoted here should be regarded as no more than a rough approximation. In any case, temporary conditions such as full employment and high wages must have affected the results to some extent, while in addition allowance must be made for local factors such as a high standard of thrift and self-reliance which is characteristic of an area that still retains many of its rural traditions. The general conclusions reached are, however, in keeping with the experience of other almoners, and it is hoped that they may be of some use as an indication of the extent to which hospital social service is needed for medical patients and of the way in which it may be provided.

Summary

1. Over 50 per cent. of patients in a medical ward needed some form of social service.

2. The most serious problems were loss of wages, necessity to change employment, and domestic difficulties.

3. Comparison with a previous survey suggests that the essence of constructive medical social work is to start treatment of potential problems before obvious social complications have had time to develop.

4. The almoner's attention should be drawn to all patients who are unlikely to return to full activity within three months, all who will need to modify their employment, diet, or other ways of life, and all who have not settled down in hospital or agreed to carry out the medical recommendations.

5. A ratio of two almoners to 100 beds and the corresponding out-patient clinics should be adequate for social service of the kind described.

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APPENDIX

DETAILS OF SOCIAL SERVICE PROVIDED

Personal Assistance		
Total number of patients helped		74
Help given included:		
Help in adjustment of emotional difficulties	14	
Long-term planning and supervision	47	
Discussions of practical social implications of medical recommendations	53	
Advice on other minor problems	9	
(55 patients in this series also required some form of material assistance.)		
Material Assistance		
Total number of patients helped		147
Help given included:		
Help in obtaining change or adjustment of employment	24	
Financial assistance	16	
Help with domestic difficulties	8	
Transport	63	
Convalescence	39	
Help in obtaining special diets	5	
Accommodation for relatives	6	
Miscellaneous minor services	16	
Total number of patients in series		355

PROPORTION OF PATIENTS REQUIRING SOCIAL SERVICE

(Excluding 20 service patients with infective hepatitis, 7 other service patients in hospital for periods of less than three weeks, and 17 civilian patients with infective hepatitis, 6 of whom required transport.)

	Per cent.
Patients with serious social problems requiring detailed and long-term case work	9
Other patients with serious social problems requiring the almoner's assistance	17
Patients requiring subsidiary social service, including transport and convalescence	27
Patients requiring advice only	6
TOTAL	59

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RISK OF JAUNDICE FOLLOWING TRANSFUSION WITH POOLED PLASMA OR SERUM

BY

LANCELOT HOGBEN, F.R.S.

It has been independently shown by Spurling, Shone, and Vaughan (1946), and by Truelove and Hogben (1947), that the use of *pooled* serum or plasma, in contradistinction to whole blood from *individual* donors, increases the risk of hepatitis following blood transfusion. This conclusion raises the elementary statistical problem: how does reduction of the number of contributors to a blood pool diminish the attendant risk of jaundice ? The issue derives some practical interest from a radical change of procedure with respect to the number of contributors to a single pool of serum or plasma during recent years. According to information supplied to the Directorate of Hygiene (War Office) by the Ministry of Health, " small pool " material (blood from 10 donors) was issued to selected transfusion centres from June to September, 1945. The writer has not been able to elicit definite information with respect to considerations which determined the decision to adopt the number 10. The object of what follows is to elucidate the issue on the basis of such figures as are available and to clarify what information would be requisite to a precise evaluation of the risks attendant on a particular pool size.

According to information supplied by the Army Transfusion Service it was customary throughout the war for soldiers treated with pooled plasma to receive from one to two bottles. For simplicity, we may here assume that each patient received one bottle without detracting from the relevance of the ensuing argument for which the following symbols suffice:

p is the proportion of donors who carry the putative virus, i.e. the incidence of the icterogenic agent in the general population;

m is the proportion of persons susceptible thereto;

P the risk of a manifest attack of jaundice consequent on transfusion from a blood sample to which n donors contribute.

The probability that no one of n donors will carry the icterogenic agent is $(1-p)^n$. The probability that *at least one* will be a carrier is the probability that this condition will not be realized. It is therefore:

$$1-(1-p)^n \qquad \text{(i)}$$

The probability of a manifest attack is that of two independent events: (*a*) that

the blood sample contains the icterogenic agent, that is, that *at least one* of the donors is a carrier; (*b*) that the individual is susceptible. Hence we have:

$$P = m(1 - \overline{1-p}^{n}) \qquad \text{(ii)}$$

If each patient receives b bottles from the same pool the above holds good, if from different pools, we have to replace n by bn in (i) and (ii) becomes:

$$P = m(1 - \overline{1-p}^{bn}) \qquad \text{(iii)}$$

Though we have not reliable estimates of m or p to determine the variation of P with respect to n in the above expression, we have some highly suggestive indications concerning the limits between which either m or p lie. Evidently m must be less than $(1-p)$ since a healthy carrier is by definition someone who is not susceptible. About 50 per cent. Army syphilitics incurred jaundice from blood distributed by imperfectly sterilized syringes before the introduction of new instructions in the fall of 1943. With due regard to the possible existence of more than one type of blood-spread icterogenic substances and to the possibility that *syphilis itself increases susceptibility* to such, we may provisionally infer that m is at least as great as $\frac{1}{2}$, and that its true value therefore lies between 0·5 and 1·0. From the data of Truelove and Hogben we have an approximate value for the Army incidence (5 per cent.) of jaundice following transfusion of pooled plasma from large samples, i.e. from 500 to 600 donors, if supplied by the Army Transfusion Service or from 300 if supplied from civilian centres. On the basis of a larger sample Spurling, Shone, and Vaughan cite an incidence of 7 per cent. Let us therefore assume that the range $m = 0{\cdot}25,\ 0{\cdot}50,\ 0{\cdot}90$ and the range $nb = 300,\ 500,\ 700$ defines the limits within which a representative estimate of p will lie. To evaluate p subject to these conditions we may write (iii) in the form:

$$bn \log (1-p) = \log (m-P) - \log m \qquad \text{(iv)}$$

By taking P as 0·06 (6 per cent.) we then get the values for p shown in Table I.

TABLE I

m	bn		
	300	500	700
0·10	0·00305	0·00183	0·00131
0·50	0·000426	0·000256	0·000183
0·90	0·000229	0·000138	0·000098

We may now tabulate (Table II) the result of using (ii) to evaluate P for different values of n in accordance with the least, the median, and the greatest values of p in Table I and the appropriate value of m corresponding to each such estimate.

On the basis of the tentative figures used for the estimates given above, it appears that reduction of the size of the pool from 500 to 10 entails a very substantial

reduction of the risk of infection; but this conclusion is by no means obvious. Its validity depends on the values assigned to the incidence of the icterogenic virus in the general population. The foregoing calculations assume a value for *m* suggested by the incidence of jaundice *in the syphilitic population.* This is open

TABLE II

p	*bn*								
	1	3	5	9	10	25	100	200	500
0·000098	0·000088	0·00027	0·00045	0·00080	0·00088	0·00222	0·0087	0·0174	0·044
0·000256	0·000128	0·00038	0·00064	0·00115	0·00127	0·00319	0·0126	0·0252	0·060
0·00305	0·000305	0·000912	0·00152	0·00271	0·00301	0·00760	0·0271	0·0451	0·078

to criticism that syphilis may itself be propitious to the pathogenic action of the virus; and there is indeed some evidence (Truelove and Hogben, 1947) to support this surmise. Among Army patients who received transfusion of whole blood from *single* donors, the incidence of jaundice was 0·81 per cent. If we take this figure *at its face value* we may put

$$mp = 0{\cdot}0081$$

and

$$m(1-\overline{1-p}^{bn}) = 0{\cdot}05$$

If we take *bn* as 500, we derive 0·16 as our estimate of *p*. On the basis of the value we obtain the following estimate of the relative risks attendant on transfusion from pools from 1, 5, 10, 25, and 100 donors:

1	5	10	25	100
1·0	3·6	5·0	6·2	6·25

The statistical error on the value assigned to *mp* in this context is *very large.* Spurling, Shone, and Vaughan did not in fact record any case of jaundice in a larger sample of patients who received blood from individual donors. It would therefore be unjustifiable to cite the figures of the last table as evidence for the view that the reduction of donors contributing to a pool from 500 to 10 does not conspicuously reduce the attendant risk of jaundice. What such figures do serve to show is the need for more exact statistics than those at present available, as a rational basis for a decision of the sort under consideration.

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